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ABSTRACT

A STANDARDIZED AND PORTABLE, FIELD BIOASSAY TO EVALUATE INTERIOR RESIDUAL SPRAYS FOR CONTROL OF MALARIA

By

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Interior (or indoor) residual spraying (IRS) is the practice of indoor application of residual insecticides or repellents as a way to halt the malaria life cycle either by insecticidal action or prevention of mosquito entrance (Diabate *et al.* 2006; Bouma *et al.* 2005; Rowland *et al.* 2000). The World Health Organization recommends the inclusion of IRS in malaria control programs where the sprays are appropriate (WHO, 2006). However, there is currently no standardized field method to evaluate the susceptibility of vectors to available insecticides or repellents. Previous studies have used a variety of techniques to evaluate local abatement efforts, usually involving only one insecticide for evaluation of efficacy. The lack of a standardized field assay prevents comparison of these studies and it limits choice of control methods to one or two tested chemicals in a certain area of interest. After testing our standardized, field bioassay in northern Belize, we trapped 2193 mosquitoes belonging to seven species and five genera over the study period. However, no statistical differences with respect to trap rates were found between

any of the insecticides, control, and standard tents, therefore, we conclude that IRS in military issued two-person tents are not effective or significant at stopping mosquito entrance. Further studies on implementation of a portable, field bioassay should include looking at the difference between contact irritants and spatial repellents in different sized tents, as spatial repellency may be more important in smaller sized tents.

Since statistical analysis verified that the insecticides utilized were not effective or significant at stopping mosquito entrance, we further attempted to use this methodology as a way to determine how mosquito populations were altered after the first tropical storm(s) of the season in northern Belize. We also studied the differences and effectiveness between two mosquito traps (Mosquito Magnet™ and CDC light traps) baited with and without octenol. Our results suggest that malaria risk in Belize declines immediately after a tropical storm or hurricane, but arboviral risk associated with culicine mosquitoes may increase. In general, our trap studies showed that the Mosquito Magnet™ always obtained a much higher yield of mosquitoes compared to its CDC counterpart. In addition, the unbaited CDC traps were unable to trap a single *Anopheles spp.* throughout the study period; therefore, we conclude that octenol may serve as an effective attractant for *An. crucians* in northern Belize.

KEY WORDS (Indexing): Interior residual sprays (IRS), malaria, *Anopheles*, mosquito, insecticides, vector control, vector ecology, hurricane preparedness

Uniformed Services University of the Health Sciences

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By

Meredith Gilman Morrow

Thesis submitted to the Faculty of the Department of Preventive Medicine and Biometrics of the Uniformed Services University of the Health Sciences in partial fulfillment of the requirements for the degree of Master of Science in Public Health.

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CHAPTER 1

Introduction

Public Health Importance of Malaria

The threat of mosquito-borne disease transmission continues to be a serious public health problem worldwide, particularly in tropical and subtropical climates (WHO 2007). Every year approximately 300-500 million acute cases of malaria occur worldwide, resulting in more than one million deaths annually (CDC 2008; WHO 2007). Not only is malaria a severe public health problem, it is also a major threat to socio-economic development in countries plagued by the disease. For instance, in sub-Saharan Africa (where malaria has the greatest prevalence), 15% of all disability life-years are lost solely to this disease (WHO 2007).

Malaria transmission, in most ecosystems, is complex and involves the interactions of the host-vector-parasite triad, environment and socio-economic factors within the community. Often conventional treatment and control strategies are proven ineffective, too complicated, or simply too expensive for impoverished communities to implement. Two of the complexities that enter into control are how to treat multi-drug resistant malaria and how to control vector mosquitoes which have been proven resistant to specific insecticides. In addition, in certain parts of the world agricultural practices (which are necessary to stimulate local economies) also provide more breeding sites for vectors, thus producing higher infection rates. Therefore, there is a need for developing holistic malaria control interventions with adequate consideration and respect of socio-economic factors which are equally important as biomedical, parasitological and entomological factors in determining infection and transmission of malaria in the community (WHO 2007).

While much progress has been made in research and control of malaria since 1997 when the Multilateral Initiative on Malaria (MIM) began as an international alliance of organizations and individuals concerned about the state of malaria research, it is clear that the malaria burden has not yet been solved (WHO 2007). However, one of the greatest benefits of these and other malaria initiatives have been the innovative development and application of research findings to patient management, disease prevention, and emergency situations.

Malaria in Belize

Belize is the second smallest country in Central America. Approximately 301,270 people live in Belize with 33.5% of that population living below the poverty line (CIA Factbook 2008). The country is divided into six districts for the purposes of administration. Bordering Mexico to the north are Corozal and Orange Walk Districts, Belize and Cayo Districts are in the middle of the country, while Stann Creek and Toledo Districts are on the south bordering Guatemala (Fig. 1 & 2). Tourism is the number one commodity, followed by exports of marine products, citrus, sugar cane, and bananas (CIA Factbook 2008).

The occurrence of malaria in Belize is generally lower in comparison to other Central and South American countries. In 2000, the prevalence reported to the World Health Organization was 656.6 per 100,000 people (UN 2000). While risk is present year-round in most areas of the country lower than 400 meters elevation, risk is particularly great during and after the rainy season (CDC 2008). Overall, malaria incidence is highest in the southern districts, however, most *Plasmodium falciparum* cases are reported from the northern districts (CDC 2008; Hakre *et al.* 2004). *P. vivax*

causes 96% of cases, *P. falciparum* 4%, and there are occasional cases are due to *P. malariae* (CDC 2008). As of 2008, Chloroquine-resistant falciparum malaria has not been reported in Belize (CDC 2008).

Malaria infections (*P. falciparum* and *P. vivax*) were chronic public health problems in Belize prior to the beginning of the use of dichloro-diphenyl-trichloroethane (DDT) in the 1950s. In 1930, over 10% of all hospital deaths in Belize were due to malaria (Roberts *et al.* 2002). In 1939, an estimated 40% of all hospital patients and 50% of the population outside of Belize City were thought to have malaria (Roberts *et al.* 2002).

In 1950, United Nations Children's Fund (UNICEF) helped Belize establish an Interior (or Indoor) residual spraying (IRS) program using DDT to assist in reducing malaria rates. The utilization of this program decreased malaria cases by approximately 80% before the Malaria Eradication Program was even initiated by the World Health Organization (WHO) in 1957 (Brown *et al.* 1976). By 1957, malaria rates were drastically reduced and in 1963, malaria seemed to disappear entirely from Belize (PAHO 1986). By 1988, Belize was pressured by the United States Agency for International Development to stop using DDT due to environmental concerns (Attaran *et al.* 2000). Shortly after, Belize banned the use of DDT for agricultural use and greatly reduced its use in public health for malaria prevention (Attaran *et al.* 2000). By 1993, Belize ordered complete termination of the use of DDT in all public health programs (Attaran *et al.* 2000). However, due to rising malaria rates after the discontinuation of DDT, the Belizean government returned to the use of DDT for IRS on a restricted basis in 1995. However, in May 2008 (shortly before the start of this project), DDT was yet

again banned countrywide in Belize (MOH 2008). Jorge Polanco (of the Ministry of Health in Belize) stated that Belize has chosen to use deltamethrin (a pyrethroid insecticide that costs three to four times as much as DDT) as a substitute (Raloff 2000). However, purchasing this insecticide now uses up to 89% of the country's budget for malaria control, leaving little for surveillance, eradication of mosquito breeding grounds, and malaria treatment (Raloff 2000).

Endemic Mosquitoes of Belize

As of 2002, there were 111 mosquito species in 17 different genera known to occur in Belize (Pecor *et al.* 2002). What follows is a list of common mosquitoes (anophelines and culicines) found in Northern Belize (Orange Walk District) where our study took place.

Anopheline mosquitoes (Anophelinae)

Only mosquitoes of the genus *Anopheles* transmit the four parasites (*Plasmodium falciparum, P. vivax, P. malaria,* and *P. ovale*) that cause human malaria. Although there are over 400 species of *Anopheles*, only about 70 are malaria vectors, and of these probably only about 40 serve as important vectors (Service 2000). Pecor *et al.* (2002) noted that there were eleven species of *Anopheles* in Belize, with six being competent vectors of malaria: *An. pseudopunctipennis* Theobald*, An. punctimacula* Dyar and Knab*, An. vestitipennis* Dyar and Knab*, An. albimanus* Wiedemann, *An. crucians* Wiedemann and *An. darlingi* Root (Clark-Gil and Darsie 1983).

Anopheles larvae occur in many different types permanent habitats, ranging from fresh and salt water swamps, ditches, rice fields, edges of streams and rivers, to ponds

and borrow pits (Service 2000). They are also found in small, and often temporary, breeding places such as puddles, hoof prints, and discarded containers (Service 2000). Visually, *Anopheles* mosquitoes can be differentiated from culicine mosquitoes by the absence of a siphon in the larval stage and the presence of long palpi in the adult stage.

Belize has a very hot and humid rainy season, which occurs from May to November, and a dry season which lasts from February to May which greatly effects seasonality of mosquito vectors (CIA 2008). In research completed by Hakre *et al.* (2004), malaria rates in Belize from 1989 to 1999 showed a consistent spatial and temporal pattern: southern and western areas of Belize had consistently higher rates of malaria than northern areas, and statistically significant differences existed ($p < 0.05$) among months of the year with highest rates occurring from June-August (the height of the rainy season).

Villages with the highest malaria rates were also in close proximity to forests, agricultural land, and wetland vegetation. This correlates with the distribution and breeding habitats of *Anopheles vestitipennis*, a species that has been determined to be an important vector of malaria in Belize (Hakre *et al.* 2004). *An. vestitipennis* also prefers to feed inside houses and had higher minimum field infection rates than *An. albimanus* or *An. darlingi* (Roberts *et al.* 1993; Bangs 1999; Achee *et al.* 2000). Southern Belize has more broadleaf forests, extensive river systems, and usually experiences more rainfall than northern areas, thus providing adequate support for the life cycles of *An. darlingi*, *An. vestitipennis*, and *An. albimanus* (Manguin *et al.* 1996; Roberts *et al.* 1993; Grieco 2001).

An. albimanus tends to breed in fresh or brackish waters such as pools, puddles, marshes, and ponds – especially those containing floating or grassy vegetation (WRBU 2008). *An. albimanus* adults tend to feed on humans and domestic animals both indoors and outdoors, however, after feeding, adults generally rest indoors (WRBU 2008; Service 2000).

An. crucians larvae are found in lakes, ponds, swamps and semi-permanent and permanent pools (WRBU 2008; Service 2000). They are associated with aquatic vegetation and usually under partly shaded conditions (Grieco *et al.* 2006; WRBU 2008). They are primarily outdoor night biters, but will some times bite during the day under shade (WRBU 2008). They rest during day underneath houses, bridges, trees, culverts and similar shelters (Service 2000).

Grieco *et al.* (2006) found that anthropogenic land use changes in Belize may alter natural patterns of malaria transmission. They determined that phosphorus input from sugarcane cultivation in northern Belize poses a significant environmental impact on malaria transmission by changing vegetation structure and composition of wetlands thereby affecting associated larval habitats (Grieco *et al.* 2006). They found that a positive correlation existed between marshes adjacent to agricultural activities and presence of *Typha* spp. of aquatic plants (Grieco *et al.* 2006). In turn, they found that *An. albimanus* was negatively correlated with percentage of cover of *Typha*, but was positively correlated with light *Eleocharis cellulosa* cover and presence of cyanobacterial mats (Grieco *et al.* 2006). On the other hand, *An. vestitipennis* was positively correlated with percentage of cover of *Typha* while *An. crucians* was positively correlated with heavy *Eleocharis cellulosa* cover (Grieco *et al.* 2006). These results indicate that marshes

in proximity to agricultural fields are conducive for *Typha* growth, thereby providing habitat for the more efficient malaria vector (*An. vestitipennis*).

Culicine mosquitoes (Culicinae)

***Culex (Culex)* spp. – Groundwater/Container breeder**

Culex mosquitoes are generally established world-wide, with the exception of, the most northern parts of temperate regions (Service 2000). Most *Culex* species breed in ground collections of water such as pools, puddles, ditches, borrow pits and rice fields (Service 2000). Some lay eggs in man-made container habitats such as trash cans, bird baths, and storage tanks (Service 2000). The most medically important *Culex* vector is *Culex quinquefasciatus*, which is a filariasis vector and breeds in water heavily polluted with organic debris (WRBU 2008). *Cx*. *quinquefasciatus,* and many other *Culex* species, bite humans and other hosts at night. However, some species (including *C*. *quinquefasciatus*) commonly rest indoors both before and after feeding (WRBU 2008). Determination of the *Culex* spp. mosquitoes below the subgenus level is often difficult to impossible when based solely on morphological characters of one sex. The principle species of concern in Belize are members of the *Culex* (*Culex*) subgenus.

***Aedes taeniorhynchus* Wiedeman - Floodwater breeder**

Aedes mosquitoes are found world-wide with their distribution extending well into northern and Arctic areas where they can be vicious biters and severe pests. *Aedes* eggs can withstand desiccation and can remain viable without moisture for many months (depending on the species). When flooded, some eggs hatch within a few minutes, while others, of the same batch, may require prolonged immersion in water (WRBU 2008).

Thus, hatching may be spread out over a period of days. The life cycle of *Aedes* mosquitoes from eggs to adults can be rapid, taking as little as approximately 7 days to reach maturity (WRBU 2008; Service 2000). *Aedes taeniorhynchus* is a competent vector of Venezuelan equine encephalitis virus, and in vitro has been shown to be a competent vector of Rift Valley fever virus (Brault *et al.* 2002; Gargan *et al.* 1998). This suggests that if Rift Valley fever was introduced into North America, this species may be capable of transmitting it (Gargan *et al.* 1998).

***Mansonia titillans* Walker - Permanent breeder**

Mansonia is principally a genus of tropical areas, but a few species occur in temperate regions as well. Larvae and pupae live associated with aquatic plants, obtaining oxygen from the plant roots and ingesting suspended organic matter by filter feeding (UF 2004). Seasonality of *Mansonia* is therefore associated with the phenology of local host plants (UF 2004; Service 2000). *Mansonia* spp. are usually lake, pond, and/or swamp species that are assigned to the permanent water group and can be vectors of filariasis (UF 2004; WRBU 2008). The habit of *Mansonia* larvae and pupae to remain affixed to the roots of aquatic plants is regarded as an adaptation for obtaining oxygen without surfacing. Larvae attached to roots are less susceptible to vertebrate and invertebrate predators than free-swimming larvae (Lounibos 1992). The shading of light by aquatic plants reduces the efficiency of *Mansonia* detection by *Gambusia holbrooki*, however, predation likely still occurs to some degree (Lounibos 1992).

***Coquillettidia nigricans* Coquillett –Permanent breeder**

Most species in this genus are found in tropical settings, although a few species may also occur in temperate areas. Besides being notorious biting pests, *Cq. perturbans* is

also a vector of eastern equine encephalitis virus in North America, while *Cq. crassipes* can be a vector of filariasis in Malaysia (WRBU 2008; Service 2000). The females of several species readily attack humans during the day and/or at night (WRBU 2008). As with *Mansonia*, larvae and pupae of *Coquillettidia* also attach to plants in order to obtain oxygen. Because of this characteristic, *Coquillettidia* and is sometimes referred to as a subgenus of *Mansonia*- the main difference between the two being that *Coquillettidia* have larval antennae that are much longer than those in *Mansonia*, and adults have narrow wing scales, not broad wing scales as is observed in *Mansonia* (Service 2000).

***Psorophora ferox* Humboldt and *Ps. albipes* Theobald - Floodwater breeder**

Psorophora mosquitoes are of only minor medical importance. Although some species are vectors of Venezuelan equine encephalitis virus, this genus is mainly noted for their large size and vicious biting habits (Sudia *et al.* 1975). *Psorophora* mosquitoes can be found from Canada to South America and are similar in many respects to *Aedes* spp. Both *Aedes* and *Psorophora* eggs can resist desiccation, therefore, breeding habitat for *Psorophora* spp. are generally in areas that are flooded frequently throughout the year (WRBU 2008).

The History of Interior/Indoor Residual Sprays (IRS) in Malaria Control

The interior residual spray (IRS), more commonly referred to as "indoor residual spray" when used in homes and other permanent structures, is an accepted and proven method of controlling insect disease vectors, particularly in malaria control programs (WHO 2006). A residual insecticide is one that remains active for a considerable period of time and which is placed where a mosquito is likely to come into contact with it in

order to pick up a "lethal dose." However, new research, that will be discussed in the following pages, has shown that insecticidal action from IRS may not be as important as originally assumed when compared to repellency and irritancy effects. IRS relies on the theory that most mosquito bites take place inside while people are asleep in their homes. Therefore, recognizing the amount of endophagy/endophily a vector exhibits is crucial when determining if IRS implementation is practical. After an adult mosquito emerges from its pupal state, females will go in search of a blood meal. After a mosquito obtains a blood meal it will then rest on the wall (inside of a human residence), digesting the blood before returning outside to oviposit. Theoretically, the insecticide treatment serves to kill mosquitoes that enter both prior to feeding and after obtaining a blood meal when they land on walls to rest and pick up the lethal dose. With significant mortality, the disease cycle can then be interrupted and malaria rates reduced. The solution is to shorten the average mosquito lifespan so that the malaria parasite does not have enough time to develop and migrate into the salivary glands where it can be transmitted to another human host.

DDT first became available for use in 1943, but was not used extensively until 1947 (Metselaar 1961; Webb 1952; DEPT ARMY 1962). This insecticide/repellent is an organochlorine that is highly hydrophobic, but has a good solubility in most organic solvents, fats and oils (WHO 2007). It acts by opening sodium ion channels in insect neurons, which in turn cause neurons to fire spontaneously and uncontrollably. This eventually leads to spasms and death of the insect if used in the proper concentration (WHO 2007). With the advent of this powerful insecticide during World War II, cases of malaria were drastically reduced in both military and civilian populations while vector

populations were reduced by 98% (Chima *et al.* 2003; Morel *et al.* 2005; Webb 1952; DEPT ARMY 1962).

Until 1972, the WHO had directed a program of IRS in which DDT was applied to the interior walls of houses in order to prevent malaria transmission (WHO 2007; Chima *et al*. 2003; Morel *et al.* 2005). Through this relatively effortless program, malaria was controlled and even eradicated in many areas including Europe, North America, and Japan. The most prominent exception was sub-Saharan Africa where malaria transmission was considered too complex and widespread to be controlled through IRS. However, in 1979, the WHO de-emphasized IRS and over the next several years, de-centralized its malaria eradication efforts (WHO 2007). The WHO eventually phased out the malaria eradication program for many reasons including the advent of drug resistance, possible insecticide resistance to DDT, expense, lack of governmental support, and the fear that DDT was harming the environment (WHO 2007; Roberts 2004). A new emphasis (as part of the new WHO Malaria Control Program) was placed on case detection/treatment, community participation and integrated vector management (Roberts 2004; WHO 2007). Unfortunately, worldwide malaria rates have increased since this change in policy. In 2004, out of 30 countries in Asia, Bhutan, Myanmar, and Sri Lanka were the three most malarious. In Bhutan, the malaria burden has grown 17.5-fold since the period when DDT was utilized in IRS. For Myanmar, Sri Lanka, and India, malaria rates have grown 6.7-, 6.4-, and 807-fold, respectively (Roberts 2004).

Recent studies indicate that the development of resistance was not as significant as formerly thought (Roberts 2004; Grieco *et al.* 2000). Resistance is defined as the ability of a population to survive a specific concentration of a lethal dose of a toxin that

was previously fatal to the test population (DEPT ARMY 1962). The amount of resistance in populations of insects is dependent on both the volume and frequency of applications of insecticides used against them (Hemingway and Ranson 2000; WHO 1981). Mosquitoes have many characteristics suited to rapid resistance development, including short life cycles with abundant progeny. Evaluating the efficacy of insecticides against resistant vector populations has become a main focus for the development of novel compounds to be used in vector control strategies (Brown 1986; WHO 1981). Establishment of baseline data for susceptible populations has facilitated the monitoring of resistance and has guided the appropriate use of insecticides (WHO 1981; DEPT ARMY 1962). This is important from a field perspective so that surveillance measures can continually be updated, noting mosquito resistance levels in a particular area.

One of the earliest studies on IRS that discriminated the repellency effects of DDT was completed by Altmon and Gahan (1969) in which they utilized treated tentage material to assay mortality to exposed *Anopheles quadrimaculatus*. Carbamate and most organophosphate insecticides caused 100% mortality after 24 weeks in laboratory tests and up to five weeks of field tests. It was also found that DDT never caused more than 50% mortality in the field tests, while mortality never exceeded 78% in the laboratory. Grieco *et al.* (2000) also noted significant excito-repellency by *Anopheles vestitipennis* in deltamethrin treated huts, but obtained much stronger repellency with DDT. It was found that the efficacy of DDT is not limited to its toxicity or insecticidal action— DDT also exhibits strong repellency and irritancy against vectors. Early tests of IRS assumed that disease control was a result of vector mortality in treated houses. However, Roberts and Alecrim (1991) demonstrated a strong repellency that conferred a high level of protection

for occupants of sprayed houses. This type of repellency protection persisted even though the insecticide was not the cause of significant mortality due to contact chemoreception. The end result being that if the correct dose of DDT is used, mosquitoes will not enter a treated house (repellent effect) and those that do, will not stay to feed (irritant effect). Thus the mosquitoes may not be killed, but the protection afforded the residents of a DDT treated house remains high. Based on these findings, the WHO modified its malaria control recommendations in 2006 to again include the use of DDT for IRS (WHO 2007).

There are currently 12 insecticides recommended for IRS, including DDT. Pyrethroids are another group of synthetic chemical compounds (similar to the natural chemical pyrethrins which come from *Chrysanthemum spp.* flowers) that are recommended by the WHO for use in IRS. Rowland *et al.* (2000) demonstrated up to 80% reductions in *Anopheles culifacies* abundance in alphacypermethrin treated homes in villages in Pakistan. More importantly, the villages experienced up to 95% reductions in the rates of *Plasmodium falciparum* and *P. vivax* malaria, therefore, pyrethroids such as alphacypermethrin seem to be effective at reducing malaria rates when utilized in IRS.

Pyrethroid-treated tents have also been tested for control and repellency of mosquitoes. Heal *et al.* (1995) noted a 90% reduction of bites by *Aedes* mosquitoes inside permethrin treated tents, as well as a 60% reduction outside of the tent. Hewett *et al.* (1995) also showed a 40% reduction in *Anopheles stephensi* in pyrethroid treated tents, but noted that results vary by species and that susceptibility to pyrethroids must be determined before tent sprays should be recommended as part of a malaria control program.

While pyrethroids have been deemed effective in some situations they are often expensive and have a very low residual period. DDT has the longest residual efficacy when sprayed on walls and ceilings (6-12 months depending on dosage and nature of substrate). In similar conditions, other insecticides have a much shorter residual efficacy and are generally much more expensive: pyrethroids 3-6 months, and organophosphates and carbamates 2-6 months (WHO 2007). DDT remains the most effective and least expensive insecticide for preventing malaria in much of the world. However, in many countries (including the United States) DDT is still banned and illegal to use in any agricultural or public health program. In fact, weeks before our research was set to begin, we were forced to choose an alternative insecticide to take the place of DDT in our experiment since it was recently banned in the country of Belize. Although DDT has a low acute toxicity, because of its chemical stability, it is able to accumulate in the environment through food chains and in tissues of exposed organisms (WHO 2007). Therefore, the WHO specifies that DDT should be used in public health programs only when deemed to be both necessary and functionally practical (WHO 2007). The WHO does not advocate DDT use for any type of agricultural purpose in order to prevent wide spread contamination in the environment (WHO 2007).

The Future of IRS in Malaria Control and Research Goals

While the WHO currently recommends the inclusion of IRS in malaria control programs (where the sprays are appropriate), there lacks a standardized field method to assess the susceptibility of vectors to available insecticides or repellents. Determining specific recommendations for IRS in any given situation may be very difficult since insect susceptibility changes over time. Of particular importance is choosing the most

effective insecticide for an IRS program. That choice is determined by the efficacy, availability, cost, and resistance status of the insecticide. Most research on IRS efficacy has occurred in permanent or semi-permanent houses and huts, but an area of growing interest is the use of IRS in tents. This interest is driven not only by the military's frequent use of tents, but also by the necessity of providing temporary housing for refugees and survivors of natural or man-made disasters. Residents of these tent cities are often at increased risk of acquiring vector-borne diseases like malaria, dengue and typhus. Research has shown that IRS provides an inexpensive and effective means to reduce malaria and vector populations. However, while previous studies have used a variety of techniques to evaluate local abatement efforts, this usually involves only one insecticide for evaluation of efficacy. The lack of a standardized field assay prevents comparison of these studies and it limits choice of control methods to one or two tested chemicals.

This research attempted to establish a portable and standardized field bioassay to evaluate up to four insecticides or repellents for IRS in portable, two-man military tents. The field bioassay will be inexpensive and reproducible so that it can be used to determine the best available IRS insecticides rapidly and accurately. The bioassay will be useful for quickly determining the best response during an emergency, but will also be invaluable for routine gathering of regional information. Also, a standardized bioassay will help monitor changes in vector behavior or susceptibility through time. The bioassay will be developed by standardizing tentage, surveillance methods and experimental design and analysis. The first year of the study will utilize a known site in Belize where a dependable vector population and trained workers are available. The second and third

years will replicate the study in the very different disease environments of Tanzania and Thailand, respectively.

Role of tents for Emergency and Military Shelters

As natural and human-produced disasters continue to increase worldwide, public health messages promoting local preparedness and coordinating expert planning efforts with outside agencies are increasingly important (Novick and Marr 2001). The goal of public health disaster preparedness and response is for individuals and communities to "take simple steps to ensure that they have a supply of food, water, shelter, medicine, a reliable first aid kit, and a plan to find loved ones if communication and transportation networks are disrupted" (APHA 2007).

Civilian Operations: *Hurricanes, Cyclones, Earthquakes*

Hurricane Katrina resulted in the largest national housing crisis since the Dust Bowl of the 1930s (US Government 2005). After the wake of the hurricane devastated portions of Louisiana and Mississippi on August 29, 2005, finding shelter for the thousands of people in the region became of the utmost of importance during cleanup and reconstruction (US Government 2005). The impact of this substantial displacement was felt throughout the country, with many Louisiana and Mississippi residents permanently evacuating to other parts of the country (Fig. 3). In addition, prior to landfall of Hurricane Katrina, there was a mass evacuation of people who were left in the storm's projected path which created an even more urgent need for immediate shelter. Federal Emergency Management Agency (FEMA) initially focused its efforts on finding residents short-term shelter utilizing cruise ships and trailers. However, for the months following the initial

landfall, volunteer relief workers, civilian construction workers, and other public health officers were often housed in living conditions that consisted of wooden huts and tents (US Government 2005; Caillouet *et al.* 2008). Because many mosquito-borne diseases are found in parts of the United States that are at risk for hurricanes, understanding effects of such events on vector-borne disease epidemiology is important for directing appropriate public health responses. Caillouet *et al.* (2008) showed that after Hurricane Katrina, the number of reported cases of neuroinvasive West Nile virus sharply increased in the hurricane-affected regions. They also found that in 2006, there was a >2-fold increase incidence of neuroinvasive West Nile virus in the hurricane-affected areas than in previous years (Caillouet *et al.* 2008). Since many of these cases were reported in construction workers and other cleanup crew, it is important when preparing for disasters to understand that adequate shelter is important not only for the residents, but also for volunteers and workers. One way to provide safe and effective shelters for all people involved after a natural disaster is to provide tents treated with insecticides that would act as both shelter and protection from possible increase in vector-borne diseases. More importantly, our portable, field bioassay would be used in situations like this in order to determine the most effective insecticide in this population.

A similar, although more massive situation, occurred when Tropical Cyclone Nargis struck Southwest Myanmar on May 2, 2008. The scale of destruction and loss was colossal: government figures listed 78,000 casualties with 56,000 people missing (Red Cross 2008). Additionally, the rainy season only continued to intensify after this storm passed, making disaster relief and disease prevention all the more difficult. Diarrhea, malaria, dengue fever, respiratory infections and hemorrhagic fever soon began plaguing

the remaining survivors. The International Red Cross released a statement weeks after the storm stating that, "the hazards remain and, in the pouring rain that will be with us for months, every effort must be made to prevent a second wave of disaster" (Red Cross 2008). Many intergovernmental and humanitarian relief agencies began dispersing tents (Fig. 4) as a way to attempt to house the 1.5 million people who were left homeless from this storm (Red Cross 2008). This is another situation that may have benefited from IRS in tents and reduced rates of vector-borne diseases. They would be able to monitor vector susceptibility in order to choose the most functional insecticide for this population of mosquitoes, leaving medical officers to focus their concerns on the care and treatment for other illnesses and injuries that the survivors and relief workers sustained.

On August 17, 1999, an earthquake of magnitude 7.4 on the Richter scale hit northwestern Turkey. This earthquake, known as the Kocaeli, Turkey earthquake, occurred on one of the worlds longest and best studied strike-slip faults—similar to the San Andreas Fault in California (USGS 2004). The epicenter of this earthquake was in Izmit, a developed town about 60 km from Istanbul (USGS 2004). While many homes were completely destroyed during the earthquake, some residents were able to move to other towns to live with relatives who were not affected by the earthquake. However, the event lasted for only 37 seconds, and killed approximately 17,000 people and left approximately half a million people homeless (IFRC 2001). Greece and the United Kingdom along with the International Red Cross and Red Crescent Societies were among the first agencies to pledge aid and financial support (IFRC 2001). India also supplied 32,000 tents to assist in providing shelter for residents whose homes were lost (IFRC 2001). One year later, approximately 40,000 people were still forced to live in "tent

cities" in the cities of Yalova, Kocaeli, Sakarya, Bolu and Duzce, Turkey (IFRC 2001). Again, treated tents could provide a safer living environment and reduce risk of mosquito-borne disease infection rates for these survivors.

Military Operations: *Housing during War, Refugee camps*

Identification of the most significant infectious disease threats to deployed United States military forces is important for developing and maintaining appropriate countermeasures and further supportive research. Burnette *et al.* published research in 2008 that stated that the top three endemic disease threats to U.S. deployed forces were malaria, bacteria-caused diarrhea, and dengue fever. Consequently, Western military and governments devote significant effort and money to predicting and making preventive recommendations to reduce the risk of malaria infection. However, non-immune travelers who utilize appropriate vector repellent devices and/or prescription chemoprophylaxis may still fall victim to malaria either during or after their travel in a malaria endemic country (Machault *et al.* 2008).

For the Canadian and United States military, the resulting response of the global malaria burden has generally been prescriptive (Schofield *et al.* 2007). For that reason, any risk of malaria generally warrants use of personal protective measures and chemoprophylaxis. However, in reality, malaria risk is highly variable and a one-size-fits-all strategy for protection may not be appropriate (Schofield *et al.* 2007). For deployments to areas of high risk, the traditional dogma is to treat using chemoprophylaxis. By contrast, where risk is low, justifying use of malaria interventions like chemoprophylaxis can be more challenging (Schofield *et al.* 2007). First of all, risk of malaria may not represent a meaningful operational threat. Additionally, the health

benefits derived by using preventive interventions may not clearly exceed health risks associated with their use (Schofield *et al.* 2007). Lastly, compliance with the prescribed chemoprophylaxis regimen is yet another flaw in malaria prevention in the U.S. Armed Forces.

Due to suboptimal compliance with chemoprophylaxis before, during and/or after deployments, individuals usually do not eliminate infection completely thus setting the scene for an outbreak of malaria (Kotwal *et al.* 2005). This was seen in 2003, when U.S. troops were deployed to Liberia. They were given chemoprophylaxis due to the high risk of malaria in the area; however, due to the high rate of noncompliance with the drug regimen, 69 of the 157 Marines on the mission developed malaria (US Medicine 2008). Therefore, chemoprophylaxis should not be the sole weapon against malaria, but should always be used with complementary vector control strategies.

Some military operations currently implement treated tents (Fig. 5) and/or bednets to prevent malaria transmission during deployments and training exercises. However, the insecticides utilized for treatment of tents often varies based on availability in a specific area. A study comparing the effectiveness of military tents treated with bifenthrin and permethrin compared to an untreated control tent, showed that protection against mosquitoes entering treated tents was initially 78.6% for bifenthrin treated tents and 84.3% for permethrin treated tents (Frances 2007). At 4 weeks, protection was 68.6% for bifenthrin and 50.7% for permethrin (Frances 2007). After 6 weeks, less than 34% protection was provided by either insecticide and there was no significant difference between the protection provided by either treatment. This study showed that tent treatments provided a reasonable increase in preventing the entry of mosquitoes for at

least 4 weeks, after which another application is necessary to maintain this level of effectiveness (Frances 2007).

Our portable, field bioassay could be utilized as a way to monitor vector susceptibility and observe the effectiveness of general vector control strategies currently being used as a way to protect troops (Frances 2007; Altman and Gahan 1969). The small size of the 2-man shelter tent allows for easy transportation, quick set up and easy implementation with other vector control strategies that are already in place.

Between 1957 and 2003, the United States has had 63 outbreaks of locally transmitted malaria (CDC 2008). These outbreaks occurred after local mosquitoes became infected by biting a person(s) carrying malaria parasites (acquired in endemic areas) and then transmitted malaria to local residents. Of the ten species of *Anopheles* mosquitoes found in the United States, two species (*Anopheles quadrimaculatus* and *An. freeborni*) are able to serve as competent vectors, thus there is a constant risk that malaria could be reintroduced in the United States. However, due to the United States' fast-acting healthcare system and reliable public health infrastructure, these outbreaks are often identified and treated quickly and efficiently. However, the same cannot be said for the fragile or sometimes nonexistent healthcare infrastructures in the third world countries that are often plagued with both mosquito-borne diseases and armed conflict (Volpe 2008).

Owing to the breakdown of health systems, mass population displacements, and resettlement of vulnerable refugees in camps or locations prone to vector breeding, malaria is often a major health problem during war and the aftermath of war (Graham *et al.* 2004; Rowland and Nosten 2001). Conventional responses to malaria control may be

difficult due to insecurity, inaccessibility and inadequate humanitarian and governmental agency coordination. Logistical efforts are most likely to be focused on the delivery of emergency food, medicine, clean water, blankets and shelter (tents). If the shelter materials that are distributed during camp construction were pre-treated and shown to be sufficiently persistent, a potentially effective vector control tool could be delivered with no extra demand on logistical resources (Graham *et al.* 2004).

Often times, people are unable to flee to another country in search of safety and are instead forced to stay confined to the violence within the borders of their own countries, sheltering in makeshift camps, shanty towns, or scattered in local communities. Refugee families who have successfully fled to other countries are also forced to live in camps or "tent cities," struggling to survive with what little resources that are offered to them (Fig. 6 & 7). It is at the early acute stage of an emergency, when refugee camps are first being established, that poor sanitation, malnutrition and mortality due to disease are at their worst and the environment is particularly suitable for transmission of vector-borne diseases (Volpe 2008; Rowland and Nosten 2001). On average, most refugees are solely dependent on the assistance of local governments and local or international aid agencies for their survival. Today, 42 million people around the world have fled armed conflicts and are searching for safety (Doctors Without Borders 2008). Internally displaced persons have fewer rights than refugees, yet make up almost two-thirds of the people around the world today who are seeking safety from war and violence (Doctors Without Borders 2008). Our portable, field bioassay may also be used in refugee situations to again serve as both housing and a vector monitoring tool for both refugees, doctors and volunteers who reside in these areas. Since housing (mainly small tents) are

usually implemented by non-governmental organizations in refugee camps, we suggest implementing the use of our tents as a way to reduce malaria in these populations.

Fig. 1 Country map of Belize
Image by: United States CIA World Factbook

Fig. 2 Map of Belizean Districts
Image by: United States CIA World Factbook

Fig. 3 Housing tents lined up for Hurricane Katrina victims.
Photo by: NASA Ames Research Center –
Disaster Assistance and Rescue Team (DART)

Fig. 4 Survivors from the Myanmar Cyclone stand outside their tents.
Photo by: Stan Honda (International Herald Tribune)

Fig. 5 Military troop camp utilizing tents as shelter in Iraq
Photo by: SSgt Cohen A. Young (U.S. Air Force)

Fig. 6 United Kingdom Refugee Camp in Uganda
Photo by: Havant Rotary Club

Fig. 7 A displaced Sudanese boy waiting in front of a Care tent in Nyala, Darfur
Photo by: UN mission in Sudan

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CHAPTER 2

TESTING A PORTABLE, FIELD BIOASSAY: FAILURE OF INTERIOR RESIDUAL SPRAYS IN MILITARY ISSUED TWO-MAN TENTS

TESTING A PORTABLE, FIELD BIOASSAY: FAILURE OF INTERIOR RESIDUAL SPRAYS IN MILITARY ISSUED TWO-MAN TENTS

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ABSTRACT

Background

Most studies on interior (or indoor) residual spraying (IRS) have been targeted on permanent/semi-permanent structures (Chareonviriyaphap *et al.* 2005; Grieco *et al.* 2000). In this project, we measure the utility of a portable field bioassay which can be set up quickly to determine the best response during an emergency or military situation when displaced persons are temporarily housed in tents (Graham *et al.* 2002). If successful, the bioassay would also offer a unique way to monitor vector susceptibility to commonly used insecticides, and would also be able to determine which insecticide is most efficient in individual populations.

Results

In total, 2193 mosquitoes belonging to seven species in five genera were collected over the study period. No statistical differences were found between any of the insecticides, control and standard tents utilizing the 4x4 Latin Square design, therefore, we conclude that our field bioassay which utilized IRS in military issued two-person tents are not effective or significant at stopping mosquito entrance.

Conclusion

Further studies on implementation of a portable, field bioassay should include looking at the difference between contact irritants and spatial repellents in different sized tents, as spatial repellency may be more important in smaller sized tents.

INTRODUCTION

The threat of mosquito-borne disease transmission continues to be a serious public health problem worldwide, particularly in tropical and subtropical climates (WHO, 2007). Interior (or indoor) residual spraying (IRS) is the practice of indoor application of residual insecticides or repellents as a way to halt the malaria life cycle either by insecticidal action or prevention of mosquito entrance (Diabate *et al.*, 2006; Bouma *et al.*, 2005; Rowland *et al.*, 2000). The major limiting factor for IRS is the degree of endophily and endophagy of the vector, in addition to the susceptibility of that vector to the insecticide.

Treating tents with insecticide was originally used as a malaria control tool for nomadic peoples (Motobar, 1974). The early work with DDT and dieldrin had little success owing to the poor adhesion of the formulations (wetable powder) then available, on fabrics (Bouma *et al.* 1996). Pyrethroid insecticides in suspension concentrate or micro-encapsulated formulations show better adhesion and residual efficacy and are more suitable for treatment of textiles which has enabled successful treatment of tents in recent years. While the World Health Organization (WHO) currently recommends the inclusion of IRS in malaria control programs (where the sprays are appropriate), a standardized field method to assess the susceptibility of vectors to available insecticides or repellents is lacking. Determining specific recommendations for IRS in any given situation may be

very difficult since insect susceptibility changes over time. Local epidemiological conditions and vector biologies require the use of standardized analysis of insecticide efficacy and other factors before IRS interventions can be optimally implemented. The lack of a standardized field assay prevents comparison of these studies and it may limit the choice of control methods to one or two tested chemicals in a certain area of interest.

Choosing the most effective insecticide for an IRS program should be determined by the efficacy, availability, cost and resistance status of the insecticide. Most research on IRS efficacy has occurred in permanent or semi-permanent houses and huts, but an area of growing interest is the use of IRS in tents. This interest is driven not only by the military's frequent use of tents, but also by the necessity of providing temporary housing for refugees and survivors of natural or man-made disasters. Residents of these tent cities are often at increased risk of acquiring vector-borne diseases such as malaria, dengue and typhus. Research has shown that IRS provides an inexpensive and effective means to reduce malaria cases and vector populations (Altman and Gahan, 1969; Schreck, 1991; Hewitt *et al.*, 1995; Heal *et al.*, 1995; Boulware and Beisang, 2005). However, while previous studies have used a variety of techniques to evaluate local abatement efforts, this usually involved only one insecticide for evaluation of efficacy. The lack of a standardized field assay prevents comparison of these studies and it has limited the choice of control methods to one or two tested chemicals.

This research attempted to establish a portable and standardized field bioassay to evaluate up to four insecticides or repellents for IRS in portable, two-person military tents. The field bioassay would be inexpensive and reproducible so that it could be used to determine the best available IRS insecticides rapidly and accurately. The bioassay

would be useful for quickly determining the best response during an emergency, but will also be invaluable for routine gathering of regional information. Also, a standardized bioassay would help monitor changes in vector behavior or susceptibility through time.

MATERIALS AND METHODS

Field experiments were conducted with four commercially available mosquito traps (Mosquito Magnet™) which were placed inside two-person tents utilized by the military (National Stock Number: 8340 01 026 6096). The traps were run for 12 hours (1800 h - 0600 h) from 21 May-3 June in a malarious area of northern Belize (Fig.1). Trials were conducted on approximately 607 ha of cattle pasture, bordered by mixed brush, marsh, and sugarcane habitat in Orange Walk Town, Belize. Each Mosquito Magnet™ utilized a 5-lb tank of 60% propane and 40% butane in order to produce both heat and generate carbon dioxide (a by-product of combustion). A 9 volt battery was utilized to power the fan motors and each trap was baited with the included 1600mg octenol cartridge and operated per manufacturer's instructions. The tents were made of untreated canvas and had doors at both ends which could be securely snapped closed or folded back to allow for ventilation. Each shelter half was fastened together with a row of snaps along the ridge line and, with poles, ropes and stakes to construct one tent that was approximately 2.1m long by 1.5m wide by 0.9m in height.

The trial on the first night consisted of running the traps baited with carbon dioxide and octenol without tents in order to ensure that all traps were working similarly. The following night, the traps were run again under the aforementioned specifications, however, they were now put inside two-person tents. The tents were aligned 20 m apart

from each other (Fig. 2), arranged in a line parallel to a local marsh and mosquito breeding site (approximately 100m away from the tents). The tents were left open on the side that faced the marsh (60ºNNE), while the backs of the tents were staked to the ground; however, were also left unbuttoned as to allow for proper air flow. Due to time, weather, and insecticide regulations, a 4 x 4 internally replicated Latin square design was employed to evaluate the effectiveness of treated versus untreated tents while controlling for tent site and date.

The positions of each tent were changed daily so that each tent would occupy every position during each of the test periods. After each night, mosquito collections were transferred to petri dishes, placed in shipping containers and brought back to the Uniformed Services University of the Health Sciences Medical Entomology Laboratory, Bethesda, Maryland, where they were counted and identified using keys for Central American mosquitoes (Pecor *et al.* 2002; Clark-Gil and Darsie 1983). Voucher specimens were later deposited in the United States National Museum of Natural History (Smithsonian)/Walter Reed Biosystematics Unit.

For the first part of the study, we used one control tent and treated each of the three additional tents with a different insecticide: permethrin (Defense Supply Center - 15mL of 40% concentration + 100ml water), lambda cyhalothrin (Control Solutions, Inc. - one half of pest tab™ + 100ml of water), and cyfluthrin (Bayer Environmental Science - 0.2ml + 100ml of water) as per instruction label. For application of liquid insecticides, each tent was laid flat on the ground while the insecticide was applied on the two interior sides of the tent (not on the doors or openings) with a brush in order to control application amount and evenly distribute placement. This task was performed on a cloudy

day. The tents were allowed to dry and were then staked upright. For the second part of the study, we replaced the control with a standard of 20% Dichlorvos organophosphate in the form of a one quarter width of a Vapona® strip (Spectrum group) which was hung inside of the tent, and again utilized the 4x4 internally replicated Latin Square design for analysis. The pest strip label recommended one strip per 28.3m^3, therefore, we reduced the strip to one quarter of this amount to approximately 7.1m^3. The amount utilized in this study was still more concentrated for the relatively small interior of the two-person tent. Dichlorvos pest strips are generally used for large open spaces such as in museum storage areas and warehouses. The pest strips should not be used in small, confined spaces with human inhabitants, such as in closed tents (ATSDR 1997; NPS 1993). However, by reducing the size of the strip to a size more proportionate for the interior of the tent, it enabled us to test a standard organophosphate for use in our bioassay. The total number of mosquitoes and number of each species captured was determined and precipitation during each night of the trial was noted.

Statistical Analysis

An analysis of variance model with main effects for treatment, day and site, followed by Tukey's post-hoc multiple comparisons among treatments, (SPSS 12.0.1 for Windows) was run on each individual species and on groups of species (anophelines vs. culicines). The dependent variable in each model was the number of mosquito species collected. P-values less than 0.05 were considered statistically significant. Because count data often violate the ANOVA assumptions of normality and equal variance, the results were cross-referenced with a non-parametric Kruskal Wallis test. The results were

consistent for the two tests and, therefore, the ANOVA results are presented (see Appendix A).

RESULTS AND DISCUSSION

4x4 Control Study

A total of 1177 mosquitoes, representing 4 genera and 6 species, were collected during the 4 day trial (Table 1). There were no significant differences found in the total number of species trapped based on treatment. The model remained significant for most species provided enough specimens were trapped throughout the trial. *An. vestitipennis* and *Culex (Culex)* spp. were the two groups trapped the least during the entire study period in which the model was not found to be significant. All of the *Culex* spp. trapped were identified down to the subgenus *Culex*. Due to lack of male specimens for species comparisons and identification, the *Cx. (Cx.)* spp. could not be identified down to species (J. Pecor pers. comm.). There were no significant trap site effect, however, the number of *Mansonia titillans* varied significantly over the four days of the study ($p = 0.018$). Overall, the greatest number of specimens trapped by species was *Anopheles crucians*, followed by *An. albimanus*, *Coqulletidia nigricans*, and *Mansonia titillans*. There was no precipitation recorded on any of the 4 days of our trial.

4x4 Standard Study

A total of 1016 mosquitoes, representing 5 genera and 7 species, were collected during the 4 day trial (Table 2). Compared to the control study, one additional species (*Aedes taneiorhynchus*) was noted in the standard study most likely due to an increase in

precipitation at our study site (precipitation was recorded on the last 3 days of the study). As with the control study, there were no significant differences found in the total number of species trapped based on treatment. The model remained significant for all but three species, one of which (*An. vestitipennis*) did not provide enough trapped specimens in order to assume significance throughout the trial. There were no significant trap site effects, however, the number of *Culex (Culex) spp*. varied significantly over the four days of the study ($p = 0.024$). Overall, the greatest number of individuals trapped by species trapped was *An. crucians*, followed by *Cq. nigricans*, *Mn. titillans*, and *An. albimanus*. Very few *Cx. (Cx.)* spp. and *Aedes taeniorhynchus* were trapped throughout the study period.

CONCLUSION

No statistical differences on trap rates were found between any of the insecticides, control and standard tents utilizing the 4x4 Latin Square design, therefore, we conclude that IRS using the four insecticides that we employed on two-person tents is not effective at stopping mosquito entrance. Further studies should include testing different sizes of tents and looking at the difference between contact irritants and spatial repellents in different size tents. Possible reasons include: (1) the size of the tent may not have been able to produce an effective contact irritant effect since mosquitoes were able to quickly fly into tents, reaching the bait quickly without picking up a dose of the chemical via tarsal contact, or (2) application dosage of insecticide (per application instructions) may not have been concentrated enough to elicit a residual toxic effect and should be tested again using both different insecticides and different concentrations of insecticides.

The goal of this study was not calculating efficacy of reducing human malaria rates, but instead to show that a portable field bioassay could potentially, rapidly identify which insecticide should be used in a given population to reduce mosquito entrance rates in tents. Once these issues are addressed, researching how effective a single treatment on a tent works over time (Frances 2007), and determining the efficacy of reducing malaria rates using this protocol could be tested in the future.

Weaknesses of this study include altering the initial 5x5 Latin Square design utilizing DDT due to the Belizean government's recent ban of this insecticide just weeks before the start of this project. DDT which has been shown to have a strong repellency effect may be more important when it comes to deterring mosquito entrance in small tents where contact irritancy does not seem to play a role. We attempted to replace the standard of DDT with one quarter of a Vapona® strip, however, its effectiveness mirrored the control and therefore may not have been an adequate replacement for DDT. Additionally, trap sites were not ideal due to roaming cattle (competing host attractiveness) which were able to enter the field where our tents were set up on certain nights of our study. However, since there was no difference found between insecticides and the two significant day effects did not coincide with cattle presence, this was not deemed as a crucial interruption of our study. Lastly, this study presents results and interpretations that were temporally and geographically limited and should not be extrapolated to other regions having the same vector species and seemingly similar epidemiologically or ecological characteristics.

TABLES

Table 1. Total number of specimens (by species) trapped separated by Insecticide Treatment (4x4 Control)

	An. albimanus	*An.crucians*	*An.vesti*	*Cq. nigricans*	*Mn. titillans*	*Cx. (Culex) spp.*	*Anopheles spp.*	*Culicines spp.*	Total
Control	45	115	0	44	27	14	160	85	245
Permethrin	49	126	0	24	15	12	175	51	226
Lambda Cyaholthrin	64	229	3	62	32	19	296	113	409
Cyfluthrin	81	102	0	63	39	12	183	114	297
Total	239	572	3	193	113	57	814	363	1177
P-values*	0.783	0.263	0.161	0.418	0.233	0.888	0.452	0.387	

* p-value for ANOVA F-test comparing all treatments after controlling for site and day

Table 2. Total number of specimens (by species) trapped separated by Insecticide Treatment (4x4 Standard)

	An. albimanus	*An.crucians*	*An.vesti*	*Cq. nigricans*	*Mn. titillans*	*Cx. (Culex) spp.*	*Ae. taeniorhy*	*Anopheles spp.*	*Culicines spp.*	Total
Vapona	13	118	0	87	39	14	0	131	140	271
Permethrin	36	88	2	65	37	5	0	126	107	233
Lambda Cyaholthrin	18	156	5	51	35	8	18	179	112	291
Cyfluthrin	21	75	3	49	51	15	7	99	122	221
Total	88	437	10	252	162	42	25	535	481	1016
P-values*	0.421	0.213	0.280	0.613	0.863	0.698	0.455	0.273	0.896	

* p-value for ANOVA F-test comparing all treatments after controlling for site and day

FIGURES

Figure 1. Military Issued Two-Person Tent with Mosquito Magnet™
Photo by: MG Morrow

Figure 2. Arrangement of Tents
Photo by: MG Morrow

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DISCLAIMER

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CHAPTER 3

MOSQUITO VECTOR POPULATION DYNAMICS IMMEDIATELY BEFORE AND AFTER TROPICAL STORMS ALMA AND ARTHUR IN NORTHERN BELIZE (2008)

MOSQUITO VECTOR POPULATION DYNAMICS IMMEDIATELY BEFORE AND AFTER TROPICAL STORMS ALMA AND ARTHUR IN NORTHERN BELIZE (2008)

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ABSTRACT

Mosquito populations in Belize were monitored immediately before and after the first tropical storm of the year (2008). The storm occurred at the end of the dry season and resulted in up to twenty inches of rain over the span of three days. We also studied the effectiveness of two types of mosquito traps (Mosquito Magnet™ and CDC light traps) baited with and without octenol. The total number of *Anopheles* spp. trapped before the storm was three times higher compared to the post-storm totals. Similarly, the total number of species trapped post-storm decreased by half compared to the pre-storm totals. However, significantly greater numbers of *Aedes taeniorhynchus* and *Culex (Culex)* spp. occurred after the storm. The Mosquito Magnet™ obtained a much larger trapping rate and was two times more effective at trapping *Anopheles* spp., and four times more effective at trapping culicine species compared to octenol-baited CDC light traps. We also found that the octenol baited CDC light trap compared to the unbaited CDC light trap was fourteen times more effective at trapping all species of mosquitoes, and was 3.5

times more effective at trapping culicine species Furthermore, the unbaited trap proved inefficient at trapping *Anopheles* spp. in the study area. These results suggest that malaria risk in Belize declines immediately after a tropical storm or hurricane, but arboviral risk associated with culicine mosquitoes may increase.

INTRODUCTION

Tropical storms and their effects on vector mosquito population dynamics have important roles in public health preparedness and disaster response. Studies that look at mosquito population dynamics in areas that receive significant rainfall during storm seasons can give insight into which species of mosquitoes will predominate after tropical weather. Such studies can provide an estimate of the time required for the development and recovery of potential vector populations.

This study attempted to record vector species dynamics in northern Belize immediately before and after the concurrent Tropical Storms, Alma and Arthur, which ended the Belizean dry season. On 27 May 2008, an area of low pressure strengthened into a tropical depression off the coast of Nicaragua. The storm continued to strengthen and became the first tropical storm of the 2008 Pacific hurricane season. It was named Tropical Storm Alma on 29 May 2008 (Fig. 1). Alma reached peak winds of 65 mph just before making landfall on the Northwestern coast of Nicaragua near León (NOAA 2008). Forming at 86.5ºW, Alma developed further east than any other Pacific tropical cyclone on record and was also the first tropical storm to make landfall along the Pacific coast of Central America since 1949 (NOAA 2008; ReliefWeb 2008). Heavy rainfall across Central America (including Belize) caused flash flooding and landslides in Costa Rica

and Nicaragua, and left 42,000 people without power (ReliefWeb 2008). In total, nine people were killed. Damage was estimated at $33 million USD (ReliefWeb 2008).

On 30 May 2008, Alma emerged into the Gulf of Honduras and fused with a tropical wave off the coast of Belize which became Tropical Storm Arthur one day before the official start of the 2008 Atlantic hurricane season (NOAA 2008). Tropical Storm Arthur was the first Atlantic tropical storm that formed during the month of May since 1981 (NOAA 2008). The storm made landfall in northern Belize on the Yucatan Peninsula on 31 May 2008 (Fig. 2) and remained a tropical storm over land for nearly 24 hours before weakening to a tropical depression on 1 June 2008 (NOAA 2008; ReliefWeb 2008). The rains from Arthur compounded the effects of flooding caused by Tropical Storm Alma, and together brought approximately ten inches of rain across Belize in thirty-six hours (ReliefWeb 2008). Heavy rainfall across Belize caused rivers in southern and northern Belize to overflow, causing damage to bridges and highways. The storm forced evacuations in parts of Corozal, Mexico and Orange Walk District, Belize (ReliefWeb 2008). Flash flooding reportedly killed 9 people in Belize and affected 100,000 more. Damage was estimated at $78 million USD (ReliefWeb 2008).

MATERIALS AND METHODS

Mosquito Magnet™ traps were used to monitor mosquito activity from 21 May-3 June in a malarious area of northern Belize. In compliance with manufacturer instructions, the traps were sheltered from rainfall, in this case inside two-person tents utilized by the military- National Stock Number: 8340 01 026 6096 (Fig. 3). The tents had previously been treated with insecticides as part of another study; however, statistical

analysis indicated the treatments were not effective and trap catches were not different from the control tent ($p=0.161$). The traps were run nightly from 1800 h to 0600 h.

Trials were conducted on an approximately 607 ha cattle pasture, bordered by mixed brush, marsh, and sugarcane habitat in Orange Walk Town, Belize. Each Mosquito Magnet™ utilized a 3.8 liter tank of 60% propane and 40% butane in order to produce both heat and generate carbon dioxide (a by-product of combustion). Each trap was baited with the included 1600mg octenol cartridge and operated per manufacturer's instructions.

In addition to the Mosquito Magnet™ traps housed in tents, we also had an additional tent which housed a Centers for Disease Control (CDC) light trap which was baited with the same 1600 mg octenol cartridge supplied with a Mosquito Magnet™ . We also utilized three unbaited CDC light traps outside of tents. The CDC traps were run over the same time period and no carbon dioxide was used.

The tents were aligned 20 m apart from each other, arranged in a line parallel to a local marsh and mosquito breeding site (approximately 100m away from the tents). The tents were left open on the side that faced the marsh (60ºNNE), while the backs of the tents were staked to the ground. The backs were also left unbuttoned to prevent overheating of the trap and resultant repellent effects of the heat. Mosquitoes from the daily trap catches were counted and identified to species using a dichotomous key (Clark-Gil and Darsie 1983; Pecor et al. 2002). Voucher specimens were later deposited in the United States National Museum of Natural History (Smithsonian)/Walter Reed Biosystematics Unit.

Statistical Analysis

Incidence rate ratios and exact binomial 95% confidence intervals are reported (Rothman 1986). Trap nights were also calculated for comparison of the octenol baited Mosquito Magnets™ with octenol baited CDC traps, and octenol baited CDC light traps (in tents) with unbaited CDC light traps (outside of tents) using STATA Statistical Software version 10.0.

RESULTS AND DISCUSSION

Mosquito Populations Pre and Post Tropical Storms

There was a significant difference in the trapping rate from octenol baited Mosquito Magnet™ traps in tents immediately before and after the storm for all species except for *Anopheles vestitipennis, Psorophora ferox, Psorophora albipes*. The traps rates for these species showed no significant difference, possibly due to the low numbers specimens trapped (Table 1). While the total number of culicine species did not change significantly, the species composition was significantly altered after the storm with significant increases in the number of *Aedes taeniorhynchus* and *Culex (Culex)* spp. All of the *Culex* spp. trapped were identified down to the subgenus *Culex*. Due to lack of male specimens for species comparisons and identification, the *Culex (Culex)* spp. could not be identified down to species (J. Pecor pers. comm.). Conversely, the total number of *Anopheles* spp. was three times higher before the storm compared to afterwards. In addition, the total number of species caught post-storm decreased by half

Anopheles crucians was the most abundant species before the storm, followed by *Coquillettidia nigricans* and *Mansonia titillans*. In addition, there were no *Aedes*

taeniorhynchus and only five *Culex* spp. specimens trapped immediately before the storm. The species trapped most often post-storm was *Mansonia titillans*, followed by *Anopheles crucians*. Significantly more *Aedes taeniorhynchus* and *Culex* spp. were trapped immediately following the storm.

Octenol Baited Mosquito Magnets™ vs. Octenol Baited CDC traps

There was a significant difference in the trapping rates between octenol-baited Mosquito Magnet™ traps in tents and octenol-baited CDC light traps for all species except *Ps. ferox* and *Ps. albipes*. The small number of these species that were trapped prevented reliable statistical analysis.

The octenol-baited Mosquito Magnet™ produced a total of 54.7 mosquitoes per trap night, while the octenol-baited CDC light trap caught a total of 20.4 mosquitoes trap night. However, the bulk of the trap rate from the CDC light trap was due to an abnormally high yield of *An. crucians* on a single night (Table 2). This was most likely due to livestock in the vicinity which served to alter the true attractiveness of the Mosquito Magnet™. After this unstable number is removed from analysis, the CDC light trap caught 11.5 mosquitoes per trap night. The octenol baited Mosquito Magnet™ was determined to be almost three times more effective at trapping all species of mosquitoes – including the one night of abnormally high trap rate of *An. crucians* in the CDC light trap. After removing this single data point from analysis, the efficiency of the Mosquito Magnet™ becomes almost five times more effective at trapping all species compared to the octenol baited CDC light trap. The Mosquito Magnet™ was also two times more

effective at trapping *Anopheles* spp., and four times more effective at trapping culicine species.

An. crucians was the species trapped most often in the Mosquito Magnet™, followed by *Mn. titillans* and *Cq. nigricans*. Despite lower numbers being trapped, this species distribution was mirrored in the octenol baited CDC trap.

Octenol baited CDC light traps in tents vs. unbaited CDC light traps outside of tents

Trap nights and associated p-values and 95% confidence intervals from octenol baited CDC light traps in tents compared to unbaited CDC light traps outside of tents are presented in Table 3. There was a significant difference in the trapping rate between octenol baited CDC light traps and unbaited CDC light traps for some species (*Anopeheles* spp*., An. crucians,* Culicine spp*.,* and *Mn. titillans),* while trap rates for other species (*An. albimanus, An. vestitipennis, Cq. nigricans, Culex* spp*., Ae. taeniorhynchus, Ps. ferox*, and *Ps. albipes*) showed no significant difference, primarily due to the low trap rates. However, the octenol baited CDC light traps were more effective overall with a trap rate of 19.3 total mosquitoes per trap night, while the unbaited CDC light trap outside of tents trapped only 1.4 total mosquitoes per trap night. The octenol baited CDC light trap was fourteen times more effective at trapping all species of mosquitoes, and was 3.5 times more effective at trapping culicine species. In addition, the unbaited trap proved inefficient at trapping all *Anopheles* spp. in the study area, while *An. crucians* was the species trapped most often in the octenol baited CDC light trap.

CONCLUSIONS

Due to the fact that the unbaited CDC light trap failed to collect any *An. crucians*, while the octenol baited CDC trap attracted a high number of *An. crucians,* we conclude that octenol serves as an effective attractant for this species in northern Belize. However, this number may also be relatively high due to a higher population of *An. crucians* found at our research site. Because many mosquito-borne diseases are found in parts of the world that are at risk for hurricanes and tropical storms, understanding effects of such events on local vector-borne disease epidemiology is important for directing appropriate public health responses. Caillouet *et al.* (2008) showed that after Hurricane Katrina, the number of reported cases of neuroinvasive West Nile virus disease sharply increased in the hurricane-affected regions. They also found that in 2006, there was a >2-fold increase incidence of neuroinvasive West Nile virus disease in the hurricane-affected areas than there was in previous years (Caillouet *et al.* 2008). Since many of these cases were reported in construction workers and other cleanup crew, it is important when preparing for disasters to understand that adequate shelter and mosquito-control is important not only for the residents of affected areas, but also for volunteers and workers who are responsible for dispensing healthcare and rebuilding the preexisting infrastructure in the days and weeks that follow the storm.

At our site in Belize, we noticed an increase in the variety of culicine species in as little as four days post-storm. However, we also noted a drastic drop in *Anopheles* spp. post storm, which may have implications for malaria prevention during storm seasons. Malaria in northern Belize is mesoendemic and moderately unstable, with seasonal epidemic exacerbations showing a fairly close correlation with alterations in rainfall

(Mason and Oavalie 1965). *Anopheles* spp. populations may also be adequately disturbed (as was documented in this study) for a short while until their habitat is recovered. This suggests that malaria prevention should not be the main focus immediately following a storm (Lehman et al. 2007). However, once the *Anopheles* vectors are re-established in the environment, the increased rainfall provides suitable breeding habitat, thus setting the scene for a possible outbreak, as was seen after Hurricane Flora swept across the southern peninsula of Haiti (Mason and Oavalie 1965). Conversely, this re-stabilization period can take many weeks to months, most likely depending on the strength of the storm and associated wind speed (Lehman et al. 2007; Mason and Oavalie 1965). For this reason, natural disasters do not usually cause an immediate increase in vector-borne diseases; however, in areas that are heavily damaged, vector control may be inappropriately delayed during the most paramount of times-- following the storm when most people have not returned from their evacuation areas (Watson et al. 2007; Nasci et al. 1998). We found that *Culex* spp. in Belize are able to increase rapidly following a storm and should be regarded as a potential vector of interest immediately following heavy rainfall, especially at the end of the dry season. If hurricanes strike early in transmission season, there could be a late increase in risk after vector and host populations are re-established. *Culex* spp. are able to transmit a number of pathogens to humans such as West Nile virus and Venezuelan equine encephalitis virus and may require the most immediate control measures after heavy rainfall in Northern Belize.

TABLES

Table 1.Mosquitoes collected with octenol baited Mosquito Magnet™ traps (n=16) in tents four days before and four after the first rain at the end of the dry season.

	Number trapped before storm	**Number trapped after storm**	**(before) per trap night**	**(after) per trap night**	**I.R.R**	**I.R.R. 95% C.I.**	**p-value**
Anopheles spp.	722	223	45.1	13.9	3.2	(2.8, 3.8)	<0.0000
An. albimanus	128	30	8	1.9	4.2	(2.8, 6.6)	<0.0000
An. crucians	587	183	36.7	11.4	3.2	(2.7, 3.8)	<0.0000
An. vestitipennis	7	10	0.4	0.6	0.6	(0.2, 2.0)	0.48
Culicine spp.	415	391	25.9	24.4	1.1	(0.9, 1.2)	0.40
Cq. nigricans	264	42	16.5	2.6	6.3	(4.5, 8.9)	<0.0000
Mn. titillans	146	204	9.1	12.8	0.7	(0.6, 0.9)	0.02
Culex spp.	5	56	0.3	3.5	0.1	(0.03, 0.2)	<0.0000
Ae. taeniorhynchus	0	86	0	5.4	-	(0, 0.04)	<0.0000
Ps. ferox	0	0	0	0	-	*	1.00
Ps. albipes	0	3	0	0.2	-	(0, 2.4)	0.13
ALL	**1137**	**614**	**71.1**	**38.4**	**1.9**	**(1.7, 2.0)**	**<0.0000**

** Not enough data to calculate the 95% Confidence Interval*

Table 2. Mosquitoes collected with octenol baited Mosquito Magnet™ traps (n=32) in tents compared to trap nights from octenol baited CDC light traps (n=7) in tents

	Number trapped in Mosquito Magnet™	**Number trapped in CDC traps**	**(Mosquito Magnet™) per trap night**	**(CDC) per trap night**	**I.R.R**	**I.R.R. 95% C.I.**	**p-value**
Anopheles spp.	945	100	29.5	14.3	2.1	(1.7,2.6)	<0.0000
An. albimanus	158	0	4.9	0	-	(9.3, ∞*)	<0.0000
An. crucians	770	100	24.1	14.3**	1.7	(1.4, 2.1)	<0.0000
An. vestitipennis	17	0	0.5	0	-	(0.9, ∞)	0.03
Culicine spp.	805	43	25.2	6.1	4.1	(3.0, 5.7)	<0.0000
Cq. nigricans	306	14	9.6	2.0	4.8	(2.8, 8.9)	<0.0000
Mn. titillans	350	26	10.9	3.7	2.9	(2.9, 2.0)	<0.0000
Culex spp.	61	2	1.9	0.3	6.3	(1.8, 56.3)	<0.0000
Ae. taeniorhynchus	86	0	2.7	0	-	(5.0, ∞)	<0.0000
Ps. ferox	0	1	0	0.1	-	(0, 8.5)	0.18
Ps. albipes	3	0	0.1	0	-	(0.09, ∞)	0.55
TOTAL	**1750**	**143**	**54.7**	**20.4**	**2.7**	**(2.2, 3.2)**	**<0.0000**

** Not enough data to calculate the 95% Confidence Interval*

*** This number includes one night of an abnormally high trap rate.*

If this unstable number is removed from analysis, the new trap rate is as follows:

	Number trapped in Mosquito Magnet™	**Number trapped in CDC traps**	**(Mosquito Magnet™) per trap night**	**(CDC) per trap night**	**I.R.R.**	**I.R.R. 95% C.I.**	**p-value**
An. crucians	770	26	24.1	4.3	5.6	(3.8, 8.5)	<0.0000
TOTAL	**1750**	**69**	**54.7**	**11.5**	**4.8**	**(3.7, 6.1)**	**<0.0000**

Table 3.Trap nights from octenol baited CDC light traps in tents (n=10) compared to trap nights from unbaited CDC light traps outside of tents (n=10).

	Number trapped in Octenol baited	**Number trapped in Unbaited**	**(Baited) per trap night**	**(Unbaited) per trap night**	**I.R.R.**	**I.R.R. 95% C.I.**	**p-value**
Anopheles spp.	143	0	14.3	0	-	(38.3,∞*)	<0.0000
An. albimanus	1	0	0.1	0	-	(0.03, ∞)	0.50
An. crucians	142	0	14.2	0	-	(38.0, ∞)	<0.0000
An. vestitipennis	0	0	0	0	-	*	1.00
Culicine spp.	50	14	5.0	1.4	3.6	(1.9, 7.0)	<0.0000
Cq. nigricans	18	11	1.8	1.1	1.6	(0.7, 3.8)	0.20
Mn. titillans	29	3	2.9	0.3	9.6	(3.0, 49.6)	<0.0000
Culex spp.	2	0	0.2	0	-	(0.2, ∞)	0.25
Ae. taeniorhynchus	0	0	0	0	-	*	1.00
Ps. ferox	1	0	0.1	0	-	(0.03, ∞)	0.50
Ps. albipes	0	0	0	0	-	*	1.00
TOTAL	**193**	**14**	**19.3**	**1.4**	**13.8**	**(8.0, 25.7)**	<0.0000

** Not enough data to calculate the 95% Confidence Interval*
IRRs were not estimable for species that were not collected in the unbaited traps

FIGURES

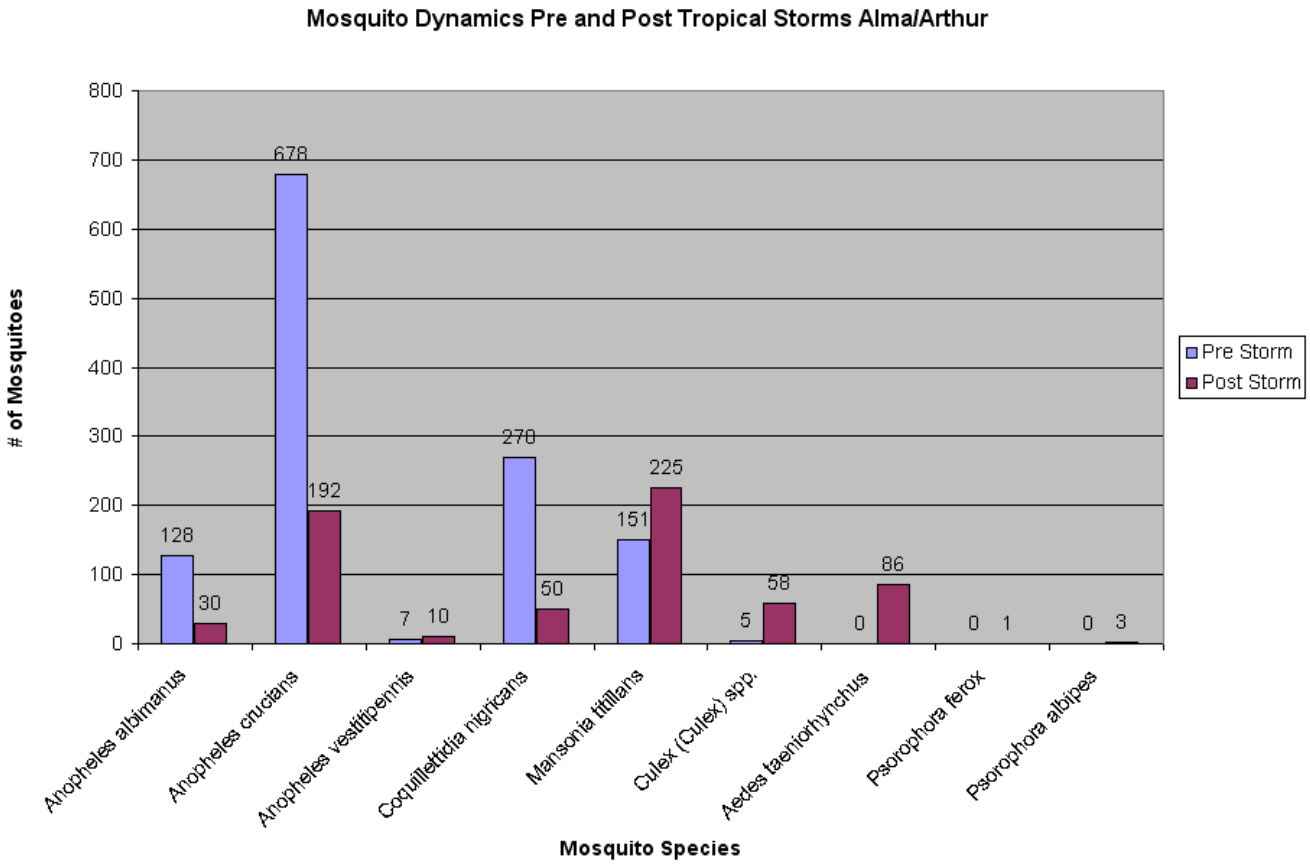

Figure 1 Mosquito Dynamics Pre and Post Tropical Storms Alma/Arthur

Figure 2 Path of Tropical Storm Alma
Image from: NOAA

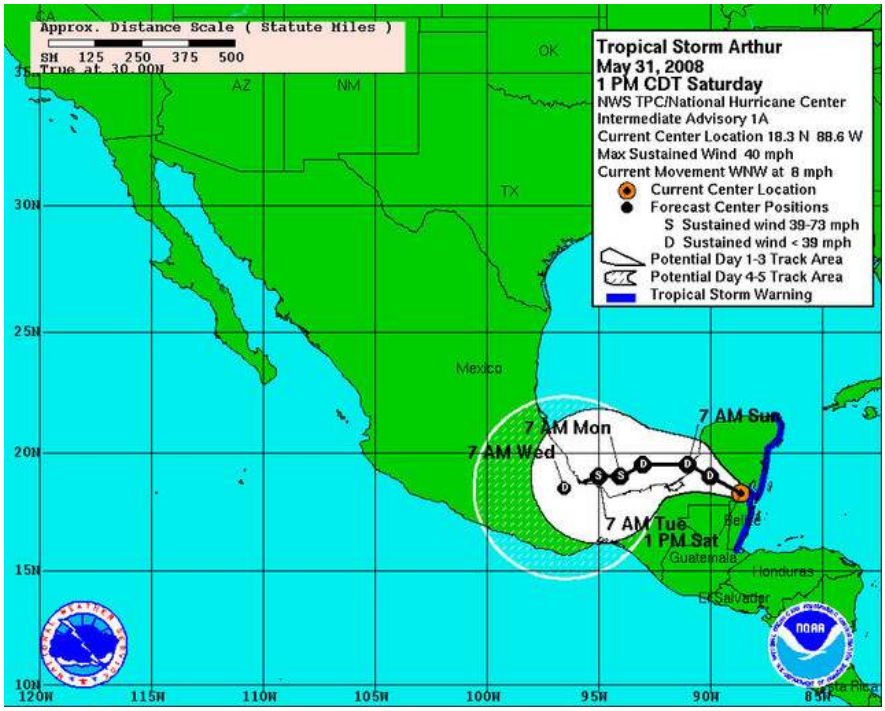

Figure 3 Path of Tropical Storm Arthur
Image from: NOAA

Figure 4 Military Issued Two-Person Tent with Mosquito Magnet™
Photo by: MG Morrow

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DISCLAIMER

This manuscript was completed in partial fulfillment of the Master of Science in Public Health degree earned at the Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, Maryland, USA. The opinions of the authors expressed in the manuscript do not reflect the views of the authors' affiliated organizations.

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CHAPTER 4

Conclusions

Conclusion and Public Health Importance of a Portable, Field Bioassay

During the construction of our portable, field bioassay, we chose the two-man tent since its small size fulfilled our need for a compact, mobile structure that could easily be set up in the field. However, the results of our initial studies show that this "small size" may not be adequate when it comes to testing contact irritant insecticides in a population of mosquitoes. These tents may have been too small to provide any type of protection as a result of contact irritancy. We suspect that once a mosquito went inside of the tent, the mosquito was almost immediately trapped and did not have any contact with the treated surface of the interior of the tent. In larger tents, there may be a greater likelihood that a mosquito will come into contact with the surface prior to being trapped and/or may not be trapped at all. The mosquito may be irritated and leave before biting due to the contact irritant effect of the insecticide. This same theory is articulated when a person sleeps under insecticide treated bed nets- since the mosquito is actually forced to go through or near the treated netting, this often deters biting completely. However, in a small tent, a mosquito may be able to go directly to the host without tarsal contact with an insecticide.

Again, while our portable, field bioassay was not successful at determining which insecticide was most useful in this population, it did show that treating the interior of small tents with contact irritants is ineffective when trying to prevent mosquito entrance. Since mosquitoes would have had the ability to land on a host and obtain a blood meal (potentially transmitting a vector-borne disease in the process) before coming into contact with an insecticide, our research showed that treating small tents with contact irritants may not be useful in preventing vector-borne disease transmission. This result has many public health implications in the real world (both in military and civilian use). Since IRS

is often studied in larger structures, there has been no past research on the size of the structure being sprayed having an influence on mosquito entrance. While we utilized mosquito traps in this experiment, we suspect that we would have similar results with using humans as bait as well. Consequently, while our bioassay was not conclusive in the field, we did determine that IRS in small tents should not be used as a single, reliable preventive measure for stopping mosquito-borne disease transmission.

Future Research on a Bioassay

Further studies can determine the effectiveness of this bioassay utilizing spatial repellents vs. contact irritants in order to note any differences in mosquito behavior based on insecticide type. In addition, implementation of a field, bioassay for the military can research the effect of IRS in larger tents- such as the Command Post (CP) tents and/or General Purpose (GP) tents. Lastly, the amount of insecticides can also be tested to determine a threshold at which mosquitoes are not trapped and/or do not enter the tent at all. Once the aforementioned issues are addressed, researching how effective a single treatment on a tent works over time, and determining the efficacy of reducing malaria rates using this protocol could be tested in the future. However, of primary importance for future testing would be to study the effects of different sized tents and different types of insecticides (spatial repellents vs. contact irritants).

Public Health Importance of Vector Dynamics after Tropical Storms

The second study was performed after the first experiment was completed. After statistical analysis verified that the insecticides utilized were not effective or significant at stopping mosquito entrance, we attempted to use this set up as a way to determine how

mosquito populations were altered after the first tropical storm(s) of the season in Northern Belize. We also studied the differences and effectiveness between two mosquito traps (Mosquito Magnet™ and CDC light traps) baited with and without octenol.

Studies that look at mosquito population dynamics in areas that receive significant rainfall during storm seasons can give insight into which species of mosquitoes will predominate and provide an average of how long after a storm one begins to notice population spikes of potential vectors. This is important when planning for mosquito control after a storm has hit and can give entomologists and technicians an idea as to how long they have before they must spray in order to keep populations of specific vectors down. Depending on the strength of storms, *Anopheles* spp. populations and habitats may be adequately disturbed (as was documented in this study) for a short while which may demonstrate that malaria prevention should not be the main focus immediately after a storm. In contrast, *Culex* spp., which are able to transmit a number of pathogens to humans, may be the main vector of interest and would require control measures immediately after storms.

Future Research (on vector dynamics studies/trap studies)

In general, our trap studies showed that the Mosquito Magnet™ always obtained a much higher yield of mosquitoes compared to its CDC counterpart. In addition, unlike the octenol baited CDC traps, the unbaited CDC traps did not collect a single *Anopheles* spp. throughout the study period. Therefore, we conclude that octenol serves as an effective attractant for *An. crucians* in northern Belize. Ideally, this study would be repeated again in both Belize and in other areas in order to determine if octenol remains

attractive for *Anopheles* spp. in Belize and if populations outside of this area are attracted to octenol as well. In addition, it is important to remember that each environment varies with respect to many climatic and ecological factors, and that each tropical storm/hurricane is different from the other. Therefore, the mosquito species that arise after tropical weather (and the time it takes for their populations to spike) will vary significantly depending on the area under study. Future research should implement vector dynamics monitoring in areas that receive significant amounts of rainfall due to tropical weather so that patterns can be tracked and studied.

ANOVA Control Output

Univariate Analysis of Variance

Warnings

Subsets cannot be computed with alpha = .050
Subsets cannot be computed with alpha = .050
Subsets cannot be computed with alpha = .050

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Aetaen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	.000[a]	10	.000	.	.
Day	.000	3	.000	.	.
Site	.000	3	.000	.	.
Treatment	.000	3	.000	.	.
Error	.000	6	.000		
Total	.000	16			

a. R Squared = . (Adjusted R Squared = .)

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Analbi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	4114.125[a]	10	411.413	2.230	.169
Day	165.187	3	55.062	.298	.826
Site	178.188	3	59.396	.322	.810
Treatment	200.688	3	66.896	.363	.783
Error	1106.875	6	184.479		
Total	5221.000	16			

a. R Squared = .788 (Adjusted R Squared = .435)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.00	9.604	1.000	-33.25	33.25
	3	4.75	9.604	.957	-28.50	38.00
	4	7.50	9.604	.861	-25.75	40.75
2	1	.00	9.604	1.000	-33.25	33.25
	3	4.75	9.604	.957	-28.50	38.00
	4	7.50	9.604	.861	-25.75	40.75
3	1	-4.75	9.604	.957	-38.00	28.50
	2	-4.75	9.604	.957	-38.00	28.50
	4	2.75	9.604	.991	-30.50	36.00
4	1	-7.50	9.604	.861	-40.75	25.75
	2	-7.50	9.604	.861	-40.75	25.75
	3	-2.75	9.604	.991	-36.00	30.50

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Day	N	Subset 1
4	4	10.50
3	4	13.25
1	4	18.00
2	4	18.00
Sig.		.861

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-2.75	9.604	.991	-36.00	30.50
	C	5.25	9.604	.944	-28.00	38.50
	D	4.75	9.604	.957	-28.50	38.00
B	A	2.75	9.604	.991	-30.50	36.00
	C	8.00	9.604	.837	-25.25	41.25
	D	7.50	9.604	.861	-25.75	40.75
C	A	-5.25	9.604	.944	-38.50	28.00
	B	-8.00	9.604	.837	-41.25	25.25
	D	-.50	9.604	1.000	-33.75	32.75
D	A	-4.75	9.604	.957	-38.00	28.50
	B	-7.50	9.604	.861	-40.75	25.75
	C	.50	9.604	1.000	-32.75	33.75

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Site	N	Subset 1
C	4	11.50
D	4	12.00
A	4	16.75
B	4	19.50
Sig.		.837

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-1.00	9.604	1.000	-34.25	32.25
	3	-4.75	9.604	.957	-38.00	28.50
	4	-9.00	9.604	.787	-42.25	24.25
2	1	1.00	9.604	1.000	-32.25	34.25
	3	-3.75	9.604	.978	-37.00	29.50
	4	-8.00	9.604	.837	-41.25	25.25
3	1	4.75	9.604	.957	-28.50	38.00
	2	3.75	9.604	.978	-29.50	37.00
	4	-4.25	9.604	.969	-37.50	29.00
4	1	9.00	9.604	.787	-24.25	42.25
	2	8.00	9.604	.837	-25.25	41.25
	3	4.25	9.604	.969	-29.00	37.50

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Treatment	N	Subset 1
1	4	11.25
2	4	12.25
3	4	16.00
4	4	20.25
Sig.		.787

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Treatment	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4

Tests of Between-Subjects Effects

Dependent Variable: Ancrucians

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	24266.500[a]	10	2426.650	4.916	.032
Day	1207.500	3	402.500	.815	.531
Treatment	2537.500	3	845.833	1.714	.263
Site	72.500	3	24.167	.049	.984
Error	2961.500	6	493.583		
Total	27228.000	16			

a. R Squared = .891 (Adjusted R Squared = .710)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-7.75	15.710	.958	-62.13	46.63
	3	9.00	15.710	.937	-45.38	63.38
	4	-14.25	15.710	.802	-68.63	40.13
2	1	7.75	15.710	.958	-46.63	62.13
	3	16.75	15.710	.721	-37.63	71.13
	4	-6.50	15.710	.974	-60.88	47.88
3	1	-9.00	15.710	.937	-63.38	45.38
	2	-16.75	15.710	.721	-71.13	37.63
	4	-23.25	15.710	.502	-77.63	31.13
4	1	14.25	15.710	.802	-40.13	68.63
	2	6.50	15.710	.974	-47.88	60.88
	3	23.25	15.710	.502	-31.13	77.63

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Day	N	Subset 1
3	4	23.50
1	4	32.50
2	4	40.25
4	4	46.75
Sig.		.502

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-2.75	15.710	.998	-57.13	51.63
	3	-28.50	15.710	.352	-82.88	25.88
	4	3.25	15.710	.997	-51.13	57.63
2	1	2.75	15.710	.998	-51.63	57.13
	3	-25.75	15.710	.426	-80.13	28.63
	4	6.00	15.710	.979	-48.38	60.38
3	1	28.50	15.710	.352	-25.88	82.88
	2	25.75	15.710	.426	-28.63	80.13
	4	31.75	15.710	.278	-22.63	86.13
4	1	-3.25	15.710	.997	-57.63	51.13
	2	-6.00	15.710	.979	-60.38	48.38
	3	-31.75	15.710	.278	-86.13	22.63

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Treatment	N	Subset 1
4	4	25.50
1	4	28.75
2	4	31.50
3	4	57.25
Sig.		.278

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-2.75	15.710	.998	-57.13	51.63
	C	-3.25	15.710	.997	-57.63	51.13
	D	2.00	15.710	.999	-52.38	56.38
B	A	2.75	15.710	.998	-51.63	57.13
	C	-.50	15.710	1.000	-54.88	53.88
	D	4.75	15.710	.989	-49.63	59.13
C	A	3.25	15.710	.997	-51.13	57.63
	B	.50	15.710	1.000	-53.88	54.88
	D	5.25	15.710	.986	-49.13	59.63
D	A	-2.00	15.710	.999	-56.38	52.38
	B	-4.75	15.710	.989	-59.13	49.63
	C	-5.25	15.710	.986	-59.63	49.13

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Site	N	Subset 1
D	4	32.75
A	4	34.75
B	4	37.50
C	4	38.00
Sig.		.986

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Warnings

Post hoc tests are not performed for Site because there are fewer than three groups.
Post hoc tests are not performed for Site because error term has zero degrees of freedom.
Post hoc tests are not performed for Treatment because error term has zero degrees of freedom.
Post hoc tests are not performed for Day because error term has zero degrees of freedom.

Between-Subjects Factors

		N
Site	A	4
Treatment	1	1
	2	1
	3	1
	4	1
Day	1	1
	2	1
	3	1
	4	1

Tests of Between-Subjects Effects

Dependent Variable: Anopheles

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	13867.000[a]	4	3466.750	.	.
Site	.000	0	.	.	.
Treatment	.000	0	.	.	.
Day	.000	0	.	.	.
Error	.000	0	.		
Total	13867.000	4			

a. R Squared = 1.000 (Adjusted R Squared = .)

Univariate Analysis of Variance

Between-Subjects Factors

		N
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4
Day	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Anopheles

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	48390.500[a]	10	4839.050	5.041	.030
Site	2953.250	3	984.417	1.026	.445
Treatment	2902.250	3	967.417	1.008	.452
Day	1122.750	3	374.250	.390	.765
Error	5759.500	6	959.917		
Total	54150.000	16			

a. R Squared = .894 (Adjusted R Squared = .716)

Post Hoc Tests
Site

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-14.50	21.908	.908	-90.34	61.34
	C	12.25	21.908	.941	-63.59	88.09
	D	21.75	21.908	.759	-54.09	97.59
B	A	14.50	21.908	.908	-61.34	90.34
	C	26.75	21.908	.637	-49.09	102.59
	D	36.25	21.908	.419	-39.59	112.09
C	A	-12.25	21.908	.941	-88.09	63.59
	B	-26.75	21.908	.637	-102.59	49.09
	D	9.50	21.908	.970	-66.34	85.34
D	A	-21.75	21.908	.759	-97.59	54.09
	B	-36.25	21.908	.419	-112.09	39.59
	C	-9.50	21.908	.970	-85.34	66.34

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Site	N	Subset 1
D	4	34.00
C	4	43.50
A	4	55.75
B	4	70.25
Sig.		.419

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	10.75	21.908	.958	-65.09	86.59
	3	-24.25	21.908	.699	-100.09	51.59
	4	-15.00	21.908	.899	-90.84	60.84
2	1	-10.75	21.908	.958	-86.59	65.09
	3	-35.00	21.908	.445	-110.84	40.84
	4	-25.75	21.908	.662	-101.59	50.09
3	1	24.25	21.908	.699	-51.59	100.09
	2	35.00	21.908	.445	-40.84	110.84
	4	9.25	21.908	.973	-66.59	85.09
4	1	15.00	21.908	.899	-60.84	90.84
	2	25.75	21.908	.662	-50.09	101.59
	3	-9.25	21.908	.973	-85.09	66.59

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	33.00
1	4	43.75
4	4	58.75
3	4	68.00
Sig.		.445

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Day

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-7.50	21.908	.985	-83.34	68.34
	3	13.50	21.908	.923	-62.34	89.34
	4	-6.50	21.908	.990	-82.34	69.34
2	1	7.50	21.908	.985	-68.34	83.34
	3	21.00	21.908	.777	-54.84	96.84
	4	1.00	21.908	1.000	-74.84	76.84
3	1	-13.50	21.908	.923	-89.34	62.34
	2	-21.00	21.908	.777	-96.84	54.84
	4	-20.00	21.908	.799	-95.84	55.84
4	1	6.50	21.908	.990	-69.34	82.34
	2	-1.00	21.908	1.000	-76.84	74.84
	3	20.00	21.908	.799	-55.84	95.84

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Day	N	Subset 1
3	4	37.25
1	4	50.75
4	4	57.25
2	4	58.25
Sig.		.777

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Anvesti

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	3.625[a]	10	.362	1.582	.297
Day	.687	3	.229	1.000	.455
Site	.687	3	.229	1.000	.455
Treatment	1.687	3	.562	2.455	.161
Error	1.375	6	.229		
Total	5.000	16			

a. R Squared = .725 (Adjusted R Squared = .267)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.25	.339	.878	-.92	1.42
	3	-.25	.339	.878	-1.42	.92
	4	.25	.339	.878	-.92	1.42
2	1	-.25	.339	.878	-1.42	.92
	3	-.50	.339	.503	-1.67	.67
	4	.00	.339	1.000	-1.17	1.17
3	1	.25	.339	.878	-.92	1.42
	2	.50	.339	.503	-.67	1.67
	4	.50	.339	.503	-.67	1.67
4	1	-.25	.339	.878	-1.42	.92
	2	.00	.339	1.000	-1.17	1.17
	3	-.50	.339	.503	-1.67	.67

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Day	N	Subset 1
2	4	.00
4	4	.00
1	4	.25
3	4	.50
Sig.		.503

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	.25	.339	.878	-.92	1.42
	C	.50	.339	.503	-.67	1.67
	D	.50	.339	.503	-.67	1.67
B	A	-.25	.339	.878	-1.42	.92
	C	.25	.339	.878	-.92	1.42
	D	.25	.339	.878	-.92	1.42
C	A	-.50	.339	.503	-1.67	.67
	B	-.25	.339	.878	-1.42	.92
	D	.00	.339	1.000	-1.17	1.17
D	A	-.50	.339	.503	-1.67	.67
	B	-.25	.339	.878	-1.42	.92
	C	.00	.339	1.000	-1.17	1.17

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Site	N	Subset 1
C	4	.00
D	4	.00
B	4	.25
A	4	.50
Sig.		.503

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.00	.339	1.000	-1.17	1.17
	3	-.75	.339	.221	-1.92	.42
	4	.00	.339	1.000	-1.17	1.17
2	1	.00	.339	1.000	-1.17	1.17
	3	-.75	.339	.221	-1.92	.42
	4	.00	.339	1.000	-1.17	1.17
3	1	.75	.339	.221	-.42	1.92
	2	.75	.339	.221	-.42	1.92
	4	.75	.339	.221	-.42	1.92
4	1	.00	.339	1.000	-1.17	1.17
	2	.00	.339	1.000	-1.17	1.17
	3	-.75	.339	.221	-1.92	.42

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Treatment	N	Subset 1
1	4	.00
2	4	.00
4	4	.00
3	4	.75
Sig.		.221

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Coqnigricans

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	3142.125[a]	10	314.212	4.108	.049
Day	422.187	3	140.729	1.840	.240
Site	138.687	3	46.229	.604	.636
Treatment	253.188	3	84.396	1.104	.418
Error	458.875	6	76.479		
Total	3601.000	16			

a. R Squared = .873 (Adjusted R Squared = .660)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	5.50	6.184	.811	-15.91	26.91
	3	-7.75	6.184	.620	-29.16	13.66
	4	4.00	6.184	.913	-17.41	25.41
2	1	-5.50	6.184	.811	-26.91	15.91
	3	-13.25	6.184	.241	-34.66	8.16
	4	-1.50	6.184	.994	-22.91	19.91
3	1	7.75	6.184	.620	-13.66	29.16
	2	13.25	6.184	.241	-8.16	34.66
	4	11.75	6.184	.320	-9.66	33.16
4	1	-4.00	6.184	.913	-25.41	17.41
	2	1.50	6.184	.994	-19.91	22.91
	3	-11.75	6.184	.320	-33.16	9.66

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Day	N	Subset 1
2	4	7.00
4	4	8.50
1	4	12.50
3	4	20.25
Sig.		.241

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-1.00	6.184	.998	-22.41	20.41
	C	4.00	6.184	.913	-17.41	25.41
	D	-4.25	6.184	.898	-25.66	17.16
B	A	1.00	6.184	.998	-20.41	22.41
	C	5.00	6.184	.848	-16.41	26.41
	D	-3.25	6.184	.950	-24.66	18.16
C	A	-4.00	6.184	.913	-25.41	17.41
	B	-5.00	6.184	.848	-26.41	16.41
	D	-8.25	6.184	.577	-29.66	13.16
D	A	4.25	6.184	.898	-17.16	25.66
	B	3.25	6.184	.950	-18.16	24.66
	C	8.25	6.184	.577	-13.16	29.66

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Site	N	Subset 1
C	4	7.75
A	4	11.75
B	4	12.75
D	4	16.00
Sig.		.577

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	5.00	6.184	.848	-16.41	26.41
	3	-4.50	6.184	.883	-25.91	16.91
	4	-4.75	6.184	.866	-26.16	16.66
2	1	-5.00	6.184	.848	-26.41	16.41
	3	-9.50	6.184	.474	-30.91	11.91
	4	-9.75	6.184	.455	-31.16	11.66
3	1	4.50	6.184	.883	-16.91	25.91
	2	9.50	6.184	.474	-11.91	30.91
	4	-.25	6.184	1.000	-21.66	21.16
4	1	4.75	6.184	.866	-16.66	26.16
	2	9.75	6.184	.455	-11.66	31.16
	3	.25	6.184	1.000	-21.16	21.66

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	6.00
1	4	11.00
3	4	15.50
4	4	15.75
Sig.		.455

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Culicines

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	10524.125[a]	10	1052.413	5.725	.022
Day	1417.687	3	472.562	2.571	.150
Site	208.687	3	69.562	.378	.772
Treatment	662.188	3	220.729	1.201	.387
Error	1102.875	6	183.813		
Total	11627.000	16			

a. R Squared = .905 (Adjusted R Squared = .747)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	7.50	9.587	.860	-25.69	40.69
	3	-16.25	9.587	.401	-49.44	16.94
	4	6.00	9.587	.920	-27.19	39.19
2	1	-7.50	9.587	.860	-40.69	25.69
	3	-23.75	9.587	.161	-56.94	9.44
	4	-1.50	9.587	.998	-34.69	31.69
3	1	16.25	9.587	.401	-16.94	49.44
	2	23.75	9.587	.161	-9.44	56.94
	4	22.25	9.587	.195	-10.94	55.44
4	1	-6.00	9.587	.920	-39.19	27.19
	2	1.50	9.587	.998	-31.69	34.69
	3	-22.25	9.587	.195	-55.44	10.94

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Day	N	Subset 1
2	4	14.50
4	4	16.00
1	4	22.00
3	4	38.25
Sig.		.161

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-2.00	9.587	.996	-35.19	31.19
	C	5.50	9.587	.936	-27.69	38.69
	D	-4.25	9.587	.969	-37.44	28.94
B	A	2.00	9.587	.996	-31.19	35.19
	C	7.50	9.587	.860	-25.69	40.69
	D	-2.25	9.587	.995	-35.44	30.94
C	A	-5.50	9.587	.936	-38.69	27.69
	B	-7.50	9.587	.860	-40.69	25.69
	D	-9.75	9.587	.747	-42.94	23.44
D	A	4.25	9.587	.969	-28.94	37.44
	B	2.25	9.587	.995	-30.94	35.44
	C	9.75	9.587	.747	-23.44	42.94

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Site	N	Subset 1
C	4	17.00
A	4	22.50
B	4	24.50
D	4	26.75
Sig.		.747

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	8.50	9.587	.812	-24.69	41.69
	3	-7.00	9.587	.882	-40.19	26.19
	4	-7.25	9.587	.871	-40.44	25.94
2	1	-8.50	9.587	.812	-41.69	24.69
	3	-15.50	9.587	.436	-48.69	17.69
	4	-15.75	9.587	.424	-48.94	17.44
3	1	7.00	9.587	.882	-26.19	40.19
	2	15.50	9.587	.436	-17.69	48.69
	4	-.25	9.587	1.000	-33.44	32.94
4	1	7.25	9.587	.871	-25.94	40.44
	2	15.75	9.587	.424	-17.44	48.94
	3	.25	9.587	1.000	-32.94	33.44

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	12.75
1	4	21.25
3	4	28.25
4	4	28.50
Sig.		.424

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Cxculex

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	357.625[a]	10	35.763	2.703	.118
Day	99.187	3	33.062	2.499	.157
Site	47.188	3	15.729	1.189	.390
Treatment	8.187	3	2.729	.206	.888
Error	79.375	6	13.229		
Total	437.000	16			

a. R Squared = .818 (Adjusted R Squared = .516)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	3.75	2.572	.513	-5.15	12.65
	3	3.00	2.572	.667	-5.90	11.90
	4	7.00	2.572	.120	-1.90	15.90
2	1	-3.75	2.572	.513	-12.65	5.15
	3	-.75	2.572	.990	-9.65	8.15
	4	3.25	2.572	.614	-5.65	12.15
3	1	-3.00	2.572	.667	-11.90	5.90
	2	.75	2.572	.990	-8.15	9.65
	4	4.00	2.572	.465	-4.90	12.90
4	1	-7.00	2.572	.120	-15.90	1.90
	2	-3.25	2.572	.614	-12.15	5.65
	3	-4.00	2.572	.465	-12.90	4.90

Based on observed means.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Day	N	Subset 1
4	4	.00
2	4	3.25
3	4	4.00
1	4	7.00
Sig.		.120

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-3.50	2.572	.563	-12.40	5.40
	C	.75	2.572	.990	-8.15	9.65
	D	.50	2.572	.997	-8.40	9.40
B	A	3.50	2.572	.563	-5.40	12.40
	C	4.25	2.572	.420	-4.65	13.15
	D	4.00	2.572	.465	-4.90	12.90
C	A	-.75	2.572	.990	-9.65	8.15
	B	-4.25	2.572	.420	-13.15	4.65
	D	-.25	2.572	1.000	-9.15	8.65
D	A	-.50	2.572	.997	-9.40	8.40
	B	-4.00	2.572	.465	-12.90	4.90
	C	.25	2.572	1.000	-8.65	9.15

Based on observed means.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Site	N	Subset 1
C	4	2.25
D	4	2.50
A	4	3.00
B	4	6.50
Sig.		.420

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.50	2.572	.997	-8.40	9.40
	3	-1.25	2.572	.959	-10.15	7.65
	4	.50	2.572	.997	-8.40	9.40
2	1	-.50	2.572	.997	-9.40	8.40
	3	-1.75	2.572	.901	-10.65	7.15
	4	.00	2.572	1.000	-8.90	8.90
3	1	1.25	2.572	.959	-7.65	10.15
	2	1.75	2.572	.901	-7.15	10.65
	4	1.75	2.572	.901	-7.15	10.65
4	1	-.50	2.572	.997	-9.40	8.40
	2	.00	2.572	1.000	-8.90	8.90
	3	-1.75	2.572	.901	-10.65	7.15

Based on observed means.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	3.00
4	4	3.00
1	4	3.50
3	4	4.75
Sig.		.901

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Mantitillans

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	1203.625[a]	10	120.363	8.875	.007
Day	308.187	3	102.729	7.575	.018
Site	20.688	3	6.896	.508	.691
Treatment	76.688	3	25.563	1.885	.233
Error	81.375	6	13.563		
Total	1285.000	16			

a. R Squared = .937 (Adjusted R Squared = .831)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Mantitillans

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-1.75	2.604	.904	-10.76	7.26
	3	-11.50*	2.604	.018	-20.51	-2.49
	4	-5.00	2.604	.312	-14.01	4.01
2	1	1.75	2.604	.904	-7.26	10.76
	3	-9.75*	2.604	.036	-18.76	-.74
	4	-3.25	2.604	.623	-12.26	5.76
3	1	11.50*	2.604	.018	2.49	20.51
	2	9.75*	2.604	.036	.74	18.76
	4	6.50	2.604	.158	-2.51	15.51
4	1	5.00	2.604	.312	-4.01	14.01
	2	3.25	2.604	.623	-5.76	12.26
	3	-6.50	2.604	.158	-15.51	2.51

Based on observed means.

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

Mantitillans

Tukey HSD[a,b]

Day	N	Subset	
		1	2
1	4	2.50	
2	4	4.25	
4	4	7.50	7.50
3	4		14.00
Sig.		.312	.158

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Mantitillans

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	2.50	2.604	.776	-6.51	11.51
	C	.75	2.604	.991	-8.26	9.76
	D	-.50	2.604	.997	-9.51	8.51
B	A	-2.50	2.604	.776	-11.51	6.51
	C	-1.75	2.604	.904	-10.76	7.26
	D	-3.00	2.604	.675	-12.01	6.01
C	A	-.75	2.604	.991	-9.76	8.26
	B	1.75	2.604	.904	-7.26	10.76
	D	-1.25	2.604	.961	-10.26	7.76
D	A	.50	2.604	.997	-8.51	9.51
	B	3.00	2.604	.675	-6.01	12.01
	C	1.25	2.604	.961	-7.76	10.26

Based on observed means.

Homogeneous Subsets

Mantitillans

Tukey HSD[a,b]

Site	N	Subset 1
B	4	5.25
C	4	7.00
A	4	7.75
D	4	8.25
Sig.		.675

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Mantitillans

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	3.00	2.604	.675	-6.01	12.01
	3	-1.25	2.604	.961	-10.26	7.76
	4	-3.00	2.604	.675	-12.01	6.01
2	1	-3.00	2.604	.675	-12.01	6.01
	3	-4.25	2.604	.429	-13.26	4.76
	4	-6.00	2.604	.199	-15.01	3.01
3	1	1.25	2.604	.961	-7.76	10.26
	2	4.25	2.604	.429	-4.76	13.26
	4	-1.75	2.604	.904	-10.76	7.26
4	1	3.00	2.604	.675	-6.01	12.01
	2	6.00	2.604	.199	-3.01	15.01
	3	1.75	2.604	.904	-7.26	10.76

Based on observed means.

Homogeneous Subsets

Mantitillans

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	3.75
1	4	6.75
3	4	8.00
4	4	9.75
Sig.		.199

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

General Linear Model

Warnings

Subsets cannot be computed with alpha = .050
Subsets cannot be computed with alpha = .050
Subsets cannot be computed with alpha = .050

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Day	Pillai's Trace	2.271	1.557	18.000	9.000	.252
	Wilks' Lambda	.001	1.765	18.000	3.314	.340
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	37.653	18.827[a]	6.000	3.000	.018
Site	Pillai's Trace	1.815	.766	18.000	9.000	.700
	Wilks' Lambda	.031	.442	18.000	3.314	.888
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	6.492	3.246[a]	6.000	3.000	.181
Treatment	Pillai's Trace	2.041	1.065	18.000	9.000	.484
	Wilks' Lambda	.007	.892	18.000	3.314	.629
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	22.974	11.487[a]	6.000	3.000	.035

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Design: Day+Site+Treatment

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	Analbi	4114.125[a]	10	411.413	2.230	.169
	Ancrucians	24266.500[b]	10	2426.650	4.916	.032
	Anvesti	3.625[c]	10	.362	1.582	.297
	Anopheles	48390.500[d]	10	4839.050	5.041	.030
	Coqnigricans	3142.125[e]	10	314.212	4.108	.049
	Mantitillans	1203.625[f]	10	120.363	8.875	.007
	Cxculex	357.625[g]	10	35.763	2.703	.118
	Aetaen	.000[h]	10	.000	.	.
	Culicines	10524.125[i]	10	1052.413	5.725	.022
Day	Analbi	165.187	3	55.062	.298	.826
	Ancrucians	1207.500	3	402.500	.815	.531
	Anvesti	.687	3	.229	1.000	.455
	Anopheles	1122.750	3	374.250	.390	.765
	Coqnigricans	422.187	3	140.729	1.840	.240
	Mantitillans	308.187	3	102.729	7.575	.018
	Cxculex	99.187	3	33.062	2.499	.157
	Aetaen	.000	3	.000	.	.
	Culicines	1417.687	3	472.562	2.571	.150
Site	Analbi	178.188	3	59.396	.322	.810
	Ancrucians	72.500	3	24.167	.049	.984
	Anvesti	.687	3	.229	1.000	.455
	Anopheles	2953.250	3	984.417	1.026	.445
	Coqnigricans	138.687	3	46.229	.604	.636
	Mantitillans	20.688	3	6.896	.508	.691
	Cxculex	47.188	3	15.729	1.189	.390
	Aetaen	.000	3	.000	.	.
	Culicines	208.687	3	69.562	.378	.772
Treatment	Analbi	200.688	3	66.896	.363	.783
	Ancrucians	2537.500	3	845.833	1.714	.263
	Anvesti	1.687	3	.562	2.455	.161
	Anopheles	2902.250	3	967.417	1.008	.452
	Coqnigricans	253.188	3	84.396	1.104	.418
	Mantitillans	76.688	3	25.563	1.885	.233
	Cxculex	8.187	3	2.729	.206	.888
	Aetaen	.000	3	.000	.	.
	Culicines	662.188	3	220.729	1.201	.387
Error	Analbi	1106.875	6	184.479		
	Ancrucians	2961.500	6	493.583		
	Anvesti	1.375	6	.229		
	Anopheles	5759.500	6	959.917		
	Coqnigricans	458.875	6	76.479		
	Mantitillans	81.375	6	13.563		
	Cxculex	79.375	6	13.229		
	Aetaen	.000	6	.000		
	Culicines	1102.875	6	183.813		
Total	Analbi	5221.000	16			
	Ancrucians	27228.000	16			
	Anvesti	5.000	16			
	Anopheles	54150.000	16			

Post Hoc Tests
Day

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	1	2	.00	9.604	1.000	-33.25	33.25
		3	4.75	9.604	.957	-28.50	38.00
		4	7.50	9.604	.861	-25.75	40.75
	2	1	.00	9.604	1.000	-33.25	33.25
		3	4.75	9.604	.957	-28.50	38.00
		4	7.50	9.604	.861	-25.75	40.75
	3	1	-4.75	9.604	.957	-38.00	28.50
		2	-4.75	9.604	.957	-38.00	28.50
		4	2.75	9.604	.991	-30.50	36.00
	4	1	-7.50	9.604	.861	-40.75	25.75
		2	-7.50	9.604	.861	-40.75	25.75
		3	-2.75	9.604	.991	-36.00	30.50
Ancrucians	1	2	-7.75	15.710	.958	-62.13	46.63
		3	9.00	15.710	.937	-45.38	63.38
		4	-14.25	15.710	.802	-68.63	40.13
	2	1	7.75	15.710	.958	-46.63	62.13
		3	16.75	15.710	.721	-37.63	71.13
		4	-6.50	15.710	.974	-60.88	47.88
	3	1	-9.00	15.710	.937	-63.38	45.38
		2	-16.75	15.710	.721	-71.13	37.63
		4	-23.25	15.710	.502	-77.63	31.13
	4	1	14.25	15.710	.802	-40.13	68.63
		2	6.50	15.710	.974	-47.88	60.88
		3	23.25	15.710	.502	-31.13	77.63
Anvesti	1	2	.25	.339	.878	-.92	1.42
		3	-.25	.339	.878	-1.42	.92
		4	.25	.339	.878	-.92	1.42
	2	1	-.25	.339	.878	-1.42	.92
		3	-.50	.339	.503	-1.67	.67
		4	.00	.339	1.000	-1.17	1.17
	3	1	.25	.339	.878	-.92	1.42
		2	.50	.339	.503	-.67	1.67
		4	.50	.339	.503	-.67	1.67
	4	1	-.25	.339	.878	-1.42	.92
		2	.00	.339	1.000	-1.17	1.17
		3	-.50	.339	.503	-1.67	.67
Anopheles	1	2	-7.50	21.908	.985	-83.34	68.34
		3	13.50	21.908	.923	-62.34	89.34
		4	-6.50	21.908	.990	-82.34	69.34
	2	1	7.50	21.908	.985	-68.34	83.34
		3	21.00	21.908	.777	-54.84	96.84
		4	1.00	21.908	1.000	-74.84	76.84
	3	1	-13.50	21.908	.923	-89.34	62.34
		2	-21.00	21.908	.777	-96.84	54.84
		4	-20.00	21.908	.799	-95.84	55.84
	4	1	6.50	21.908	.990	-69.34	82.34
		2	-1.00	21.908	1.000	-76.84	74.84
		3	20.00	21.908	.799	-55.84	95.84
Coqnigricans	1	2	5.50	6.184	.811	-15.91	26.91
		3	-7.75	6.184	.620	-29.16	13.66
		4	4.00	6.184	.913	-17.41	25.41
	2	1	-5.50	6.184	.811	-26.91	15.91
		3	-13.25	6.184	.241	-34.66	8.16
		4	-1.50	6.184	.994	-22.91	19.91
	3	1	7.75	6.184	.620	-13.66	29.16
		2	13.25	6.184	.241	-8.16	34.66
		4	11.75	6.184	.320	-9.66	33.16
	4	1	-4.00	6.184	.913	-25.41	17.41
		2	1.50	6.184	.994	-19.91	22.91
		3	-11.75	6.184	.320	-33.16	9.66
Mantitillans	1	2	-1.75	2.604	.904	-10.76	7.26
		3	-11.50*	2.604	.018	-20.51	-2.49
		4	-5.00	2.604	.312	-14.01	4.01
	2	1	1.75	2.604	.904	-7.26	10.76
		3	-9.75*	2.604	.036	-18.76	-.74
		4	-3.25	2.604	.623	-12.26	5.76
	3	1	11.50*	2.604	.018	2.49	20.51
		2	9.75*	2.604	.036	.74	18.76
		4	6.50	2.604	.158	-2.51	15.51
	4	1	5.00	2.604	.312	-4.01	14.01
		2	3.25	2.604	.623	-5.76	12.26
		3	-6.50	2.604	.158	-15.51	2.51
Cxculex	1	2	3.75	2.572	.513	-5.15	12.65
		3	3.00	2.572	.667	-5.90	11.90
		4	7.00	2.572	.120	-1.90	15.90
	2	1	-3.75	2.572	.513	-12.65	5.15
		3	-.75	2.572	.990	-9.65	8.15
		4	3.25	2.572	.614	-5.65	12.15
	3	1	-3.00	2.572	.667	-11.90	5.90
		2	.75	2.572	.990	-8.15	9.65
		4	4.00	2.572	.465	-4.90	12.90
	4	1	-7.00	2.572	.120	-15.90	1.90
		2	-3.25	2.572	.614	-12.15	5.65
		3	-4.00	2.572	.465	-12.90	4.90
Culicines	1	2	7.50	9.587	.860	-25.69	40.69
		3	-16.25	9.587	.401	-49.44	16.94
		4	6.00	9.587	.920	-27.19	39.19
	2	1	-7.50	9.587	.860	-40.69	25.69
		3	-23.75	9.587	.161	-56.94	9.44
		4	-1.50	9.587	.998	-34.69	31.69
	3	1	16.25	9.587	.401	-16.94	49.44
		2	23.75	9.587	.161	-9.44	56.94
		4	22.25	9.587	.195	-10.94	55.44
	4	1	-6.00	9.587	.920	-39.19	27.19
		2	1.50	9.587	.998	-31.69	34.69
		3	-22.25	9.587	.195	-55.44	10.94

Based on observed means.

*- The mean difference is significant at the .05 level.

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Day	N	Subset 1
4	4	10.50
3	4	13.25
1	4	18.00
2	4	18.00
Sig.		.861

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Day	N	Subset 1
3	4	23.50
1	4	32.50
2	4	40.25
4	4	46.75
Sig.		.502

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Day	N	Subset 1
2	4	.00
4	4	.00
1	4	.25
3	4	.50
Sig.		.503

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Day	N	Subset 1
3	4	37.25
1	4	50.75
4	4	57.25
2	4	58.25
Sig.		.777

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Day	N	Subset 1
2	4	7.00
4	4	8.50
1	4	12.50
3	4	20.25
Sig.		.241

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Day	N	Subset 1	2
1	4	2.50	
2	4	4.25	
4	4	7.50	7.50
3	4		14.00
Sig.		.312	.158

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Day	N	Subset 1
4	4	.00
2	4	3.25
3	4	4.00
1	4	7.00
Sig.		.120

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Day	N	Subset 1
2	4	14.50
4	4	16.00
1	4	22.00
3	4	38.25
Sig.		.161

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Site

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	A	B	-2.75	9.604	.991	-36.00	30.50
		C	5.25	9.604	.944	-28.00	38.50
		D	4.75	9.604	.957	-28.50	38.00
	B	A	2.75	9.604	.991	-30.50	36.00
		C	8.00	9.604	.837	-25.25	41.25
		D	7.50	9.604	.861	-25.75	40.75
	C	A	-5.25	9.604	.944	-38.50	28.00
		B	-8.00	9.604	.837	-41.25	25.25
		D	-.50	9.604	1.000	-33.75	32.75
	D	A	-4.75	9.604	.957	-38.00	28.50
		B	-7.50	9.604	.861	-40.75	25.75
		C	.50	9.604	1.000	-32.75	33.75
Ancrucians	A	B	-2.75	15.710	.998	-57.13	51.63
		C	-3.25	15.710	.997	-57.63	51.13
		D	2.00	15.710	.999	-52.38	56.38
	B	A	2.75	15.710	.998	-51.63	57.13
		C	-.50	15.710	1.000	-54.88	53.88
		D	4.75	15.710	.989	-49.63	59.13
	C	A	3.25	15.710	.997	-51.13	57.63
		B	.50	15.710	1.000	-53.88	54.88
		D	5.25	15.710	.986	-49.13	59.63
	D	A	-2.00	15.710	.999	-56.38	52.38
		B	-4.75	15.710	.989	-59.13	49.63
		C	-5.25	15.710	.986	-59.63	49.13
Anvesti	A	B	.25	.339	.878	-.92	1.42
		C	.50	.339	.503	-.67	1.67
		D	.50	.339	.503	-.67	1.67
	B	A	-.25	.339	.878	-1.42	.92
		C	.25	.339	.878	-.92	1.42
		D	.25	.339	.878	-.92	1.42
	C	A	-.50	.339	.503	-1.67	.67
		B	-.25	.339	.878	-1.42	.92
		D	.00	.339	1.000	-1.17	1.17
	D	A	-.50	.339	.503	-1.67	.67
		B	-.25	.339	.878	-1.42	.92
		C	.00	.339	1.000	-1.17	1.17
Anopheles	A	B	-14.50	21.908	.908	-90.34	61.34
		C	12.25	21.908	.941	-63.59	88.09
		D	21.75	21.908	.759	-54.09	97.59
	B	A	14.50	21.908	.908	-61.34	90.34
		C	26.75	21.908	.637	-49.09	102.59
		D	36.25	21.908	.419	-39.59	112.09
	C	A	-12.25	21.908	.941	-88.09	63.59
		B	-26.75	21.908	.637	-102.59	49.09
		D	9.50	21.908	.970	-66.34	85.34
	D	A	-21.75	21.908	.759	-97.59	54.09

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Site	N	Subset 1
C	4	11.50
D	4	12.00
A	4	16.75
B	4	19.50
Sig.		.837

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Site	N	Subset 1
D	4	32.75
A	4	34.75
B	4	37.50
C	4	38.00
Sig.		.986

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Site	N	Subset 1
C	4	.00
D	4	.00
B	4	.25
A	4	.50
Sig.		.503

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Site	N	Subset 1
D	4	34.00
C	4	43.50
A	4	55.75
B	4	70.25
Sig.		.419

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Site	N	Subset 1
C	4	7.75
A	4	11.75
B	4	12.75
D	4	16.00
Sig.		.577

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	5.25
C	4	7.00
A	4	7.75
D	4	8.25
Sig.		.675

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Site	N	Subset 1
C	4	2.25
D	4	2.50
A	4	3.00
B	4	6.50
Sig.		.420

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Site	N	Subset 1
C	4	17.00
A	4	22.50
B	4	24.50
D	4	26.75
Sig.		.747

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Treatment

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	1	2	-1.00	9.604	1.000	-34.25	32.25
		3	-4.75	9.604	.957	-38.00	28.50
		4	-9.00	9.604	.787	-42.25	24.25
	2	1	1.00	9.604	1.000	-32.25	34.25
		3	-3.75	9.604	.978	-37.00	29.50
		4	-8.00	9.604	.837	-41.25	25.25
	3	1	4.75	9.604	.957	-28.50	38.00
		2	3.75	9.604	.978	-29.50	37.00
		4	-4.25	9.604	.969	-37.50	29.00
	4	1	9.00	9.604	.787	-24.25	42.25
		2	8.00	9.604	.837	-25.25	41.25
		3	4.25	9.604	.969	-29.00	37.50
Ancrucians	1	2	-2.75	15.710	.998	-57.13	51.63
		3	-28.50	15.710	.352	-82.88	25.88
		4	3.25	15.710	.997	-51.13	57.63
	2	1	2.75	15.710	.998	-51.63	57.13
		3	-25.75	15.710	.426	-80.13	28.63
		4	6.00	15.710	.979	-48.38	60.38
	3	1	28.50	15.710	.352	-25.88	82.88
		2	25.75	15.710	.426	-28.63	80.13
		4	31.75	15.710	.278	-22.63	86.13
	4	1	-3.25	15.710	.997	-57.63	51.13
		2	-6.00	15.710	.979	-60.38	48.38
		3	-31.75	15.710	.278	-86.13	22.63
Anvesti	1	2	.00	.339	1.000	-1.17	1.17
		3	-.75	.339	.221	-1.92	.42
		4	.00	.339	1.000	-1.17	1.17
	2	1	.00	.339	1.000	-1.17	1.17
		3	-.75	.339	.221	-1.92	.42
		4	.00	.339	1.000	-1.17	1.17
	3	1	.75	.339	.221	-.42	1.92
		2	.75	.339	.221	-.42	1.92
		4	.75	.339	.221	-.42	1.92
	4	1	.00	.339	1.000	-1.17	1.17
		2	.00	.339	1.000	-1.17	1.17
		3	-.75	.339	.221	-1.92	.42
Anopheles	1	2	10.75	21.908	.958	-65.09	86.59
		3	-24.25	21.908	.699	-100.09	51.59
		4	-15.00	21.908	.899	-90.84	60.84
	2	1	-10.75	21.908	.958	-86.59	65.09
		3	-35.00	21.908	.445	-110.84	40.84
		4	-25.75	21.908	.662	-101.59	50.09
	3	1	24.25	21.908	.699	-51.59	100.09
		2	35.00	21.908	.445	-40.84	110.84
		4	9.25	21.908	.973	-66.59	85.09
	4	1	15.00	21.908	.899	-60.84	90.84
		2	25.75	21.908	.662	-50.09	101.59
		3	-9.25	21.908	.973	-85.09	66.59
Coqnigricans	1	2	5.00	6.184	.848	-16.41	26.41
		3	-4.50	6.184	.883	-25.91	16.91
		4	-4.75	6.184	.866	-26.16	16.66
	2	1	-5.00	6.184	.848	-26.41	16.41
		3	-9.50	6.184	.474	-30.91	11.91
		4	-9.75	6.184	.455	-31.16	11.66
	3	1	4.50	6.184	.883	-16.91	25.91
		2	9.50	6.184	.474	-11.91	30.91
		4	-.25	6.184	1.000	-21.66	21.16
	4	1	4.75	6.184	.866	-16.66	26.16
		2	9.75	6.184	.455	-11.66	31.16
		3	.25	6.184	1.000	-21.16	21.66
Mantitillans	1	2	3.00	2.604	.675	-6.01	12.01
		3	-1.25	2.604	.961	-10.26	7.76
		4	-3.00	2.604	.675	-12.01	6.01
	2	1	-3.00	2.604	.675	-12.01	6.01
		3	-4.25	2.604	.429	-13.26	4.76
		4	-6.00	2.604	.199	-15.01	3.01
	3	1	1.25	2.604	.961	-7.76	10.26
		2	4.25	2.604	.429	-4.76	13.26
		4	-1.75	2.604	.904	-10.76	7.26
	4	1	3.00	2.604	.675	-6.01	12.01
		2	6.00	2.604	.199	-3.01	15.01
		3	1.75	2.604	.904	-7.26	10.76
Cxculex	1	2	.50	2.572	.997	-8.40	9.40
		3	-1.25	2.572	.959	-10.15	7.65
		4	.50	2.572	.997	-8.40	9.40
	2	1	-.50	2.572	.997	-9.40	8.40
		3	-1.75	2.572	.901	-10.65	7.15
		4	.00	2.572	1.000	-8.90	8.90
	3	1	1.25	2.572	.959	-7.65	10.15
		2	1.75	2.572	.901	-7.15	10.65
		4	1.75	2.572	.901	-7.15	10.65
	4	1	-.50	2.572	.997	-9.40	8.40
		2	.00	2.572	1.000	-8.90	8.90
		3	-1.75	2.572	.901	-10.65	7.15
Culicines	1	2	8.50	9.587	.812	-24.69	41.69
		3	-7.00	9.587	.882	-40.19	26.19
		4	-7.25	9.587	.871	-40.44	25.94
	2	1	-8.50	9.587	.812	-41.69	24.69
		3	-15.50	9.587	.436	-48.69	17.69
		4	-15.75	9.587	.424	-48.94	17.44
	3	1	7.00	9.587	.882	-26.19	40.19
		2	15.50	9.587	.436	-17.69	48.69
		4	-.25	9.587	1.000	-33.44	32.94
	4	1	7.25	9.587	.871	-25.94	40.44
		2	15.75	9.587	.424	-17.44	48.94
		3	.25	9.587	1.000	-32.94	33.44

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Treatment	N	Subset 1
1	4	11.25
2	4	12.25
3	4	16.00
4	4	20.25
Sig.		.787

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 184.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Treatment	N	Subset 1
4	4	25.50
1	4	28.75
2	4	31.50
3	4	57.25
Sig.		.278

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 493.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Treatment	N	Subset 1
1	4	.00
2	4	.00
4	4	.00
3	4	.75
Sig.		.221

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	33.00
1	4	43.75
4	4	58.75
3	4	68.00
Sig.		.445

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 959.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	6.00
1	4	11.00
3	4	15.50
4	4	15.75
Sig.		.455

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 76.479.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	3.75
1	4	6.75
3	4	8.00
4	4	9.75
Sig.		.199

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	3.00
4	4	3.00
1	4	3.50
3	4	4.75
Sig.		.901

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 13.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	12.75
1	4	21.25
3	4	28.25
4	4	28.50
Sig.		.424

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 183.813.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

ANOVA Standard Output

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Aetaen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	264.625[a]	10	26.463	1.465	.332
Day	117.187	3	39.062	2.163	.194
Site	54.188	3	18.063	1.000	.455
Treatment	54.187	3	18.062	1.000	.455
Error	108.375	6	18.063		
Total	373.000	16			

a. R Squared = .709 (Adjusted R Squared = .225)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Aetaen

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.00	3.005	1.000	-10.40	10.40
	3	.00	3.005	1.000	-10.40	10.40
	4	-6.25	3.005	.260	-16.65	4.15
2	1	.00	3.005	1.000	-10.40	10.40
	3	.00	3.005	1.000	-10.40	10.40
	4	-6.25	3.005	.260	-16.65	4.15
3	1	.00	3.005	1.000	-10.40	10.40
	2	.00	3.005	1.000	-10.40	10.40
	4	-6.25	3.005	.260	-16.65	4.15
4	1	6.25	3.005	.260	-4.15	16.65
	2	6.25	3.005	.260	-4.15	16.65
	3	6.25	3.005	.260	-4.15	16.65

Based on observed means.

Homogeneous Subsets

Aetaen

Tukey HSD[a,b]

Day	N	Subset 1
1	4	.00
2	4	.00
3	4	.00
4	4	6.25
Sig.		.260

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Aetaen

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-4.50	3.005	.493	-14.90	5.90
	C	-1.75	3.005	.934	-12.15	8.65
	D	.00	3.005	1.000	-10.40	10.40
B	A	4.50	3.005	.493	-5.90	14.90
	C	2.75	3.005	.798	-7.65	13.15
	D	4.50	3.005	.493	-5.90	14.90
C	A	1.75	3.005	.934	-8.65	12.15
	B	-2.75	3.005	.798	-13.15	7.65
	D	1.75	3.005	.934	-8.65	12.15
D	A	.00	3.005	1.000	-10.40	10.40
	B	-4.50	3.005	.493	-14.90	5.90
	C	-1.75	3.005	.934	-12.15	8.65

Based on observed means.

Homogeneous Subsets

Aetaen

Tukey HSD[a,b]

Site	N	Subset 1
A	4	.00
D	4	.00
C	4	1.75
B	4	4.50
Sig.		.493

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Aetaen

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.00	3.005	1.000	-10.40	10.40
	3	-4.50	3.005	.493	-14.90	5.90
	4	-1.75	3.005	.934	-12.15	8.65
2	1	.00	3.005	1.000	-10.40	10.40
	3	-4.50	3.005	.493	-14.90	5.90
	4	-1.75	3.005	.934	-12.15	8.65
3	1	4.50	3.005	.493	-5.90	14.90
	2	4.50	3.005	.493	-5.90	14.90
	4	2.75	3.005	.798	-7.65	13.15
4	1	1.75	3.005	.934	-8.65	12.15
	2	1.75	3.005	.934	-8.65	12.15
	3	-2.75	3.005	.798	-13.15	7.65

Based on observed means.

Homogeneous Subsets

Aetaen

Tukey HSD[a,b]

Treatment	N	Subset 1
1	4	.00
2	4	.00
4	4	1.75
3	4	4.50
Sig.		.493

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Analbi

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	704.000[a]	10	70.400	6.212	.018
Day	270.250	3	90.083	7.949	.016
Site	90.250	3	30.083	2.654	.143
Treatment	37.250	3	12.417	1.096	.421
Error	68.000	6	11.333		
Total	772.000	16			

a. R Squared = .912 (Adjusted R Squared = .765)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	7.75	2.380	.064	-.49	15.99
	3	9.00*	2.380	.035	.76	17.24
	4	10.75*	2.380	.016	2.51	18.99
2	1	-7.75	2.380	.064	-15.99	.49
	3	1.25	2.380	.950	-6.99	9.49
	4	3.00	2.380	.616	-5.24	11.24
3	1	-9.00*	2.380	.035	-17.24	-.76
	2	-1.25	2.380	.950	-9.49	6.99
	4	1.75	2.380	.880	-6.49	9.99
4	1	-10.75*	2.380	.016	-18.99	-2.51
	2	-3.00	2.380	.616	-11.24	5.24
	3	-1.75	2.380	.880	-9.99	6.49

Based on observed means.

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Day	N	Subset	
		1	2
4	4	.50	
3	4	2.25	
2	4	3.50	3.50
1	4		11.25
Sig.		.616	.064

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 11.333.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	6.25	2.380	.135	-1.99	14.49
	C	4.00	2.380	.408	-4.24	12.24
	D	5.25	2.380	.224	-2.99	13.49
B	A	-6.25	2.380	.135	-14.49	1.99
	C	-2.25	2.380	.783	-10.49	5.99
	D	-1.00	2.380	.973	-9.24	7.24
C	A	-4.00	2.380	.408	-12.24	4.24
	B	2.25	2.380	.783	-5.99	10.49
	D	1.25	2.380	.950	-6.99	9.49
D	A	-5.25	2.380	.224	-13.49	2.99
	B	1.00	2.380	.973	-7.24	9.24
	C	-1.25	2.380	.950	-9.49	6.99

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Site	N	Subset 1
B	4	2.00
D	4	3.00
C	4	4.25
A	4	8.25
Sig.		.135

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.333.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Analbi

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.50	2.380	.996	-8.74	7.74
	3	-.25	2.380	1.000	-8.49	7.99
	4	-3.75	2.380	.456	-11.99	4.49
2	1	.50	2.380	.996	-7.74	8.74
	3	.25	2.380	1.000	-7.99	8.49
	4	-3.25	2.380	.560	-11.49	4.99
3	1	.25	2.380	1.000	-7.99	8.49
	2	-.25	2.380	1.000	-8.49	7.99
	4	-3.50	2.380	.507	-11.74	4.74
4	1	3.75	2.380	.456	-4.49	11.99
	2	3.25	2.380	.560	-4.99	11.49
	3	3.50	2.380	.507	-4.74	11.74

Based on observed means.

Homogeneous Subsets

Analbi

Tukey HSD[a,b]

Treatment	N	Subset 1
1	4	3.25
3	4	3.50
2	4	3.75
4	4	7.00
Sig.		.456

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.333.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Ancrucians

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	16194.125[a]	10	1619.412	4.294	.044
Day	1479.188	3	493.063	1.307	.356
Site	2777.187	3	925.729	2.455	.161
Treatment	2284.687	3	761.562	2.019	.213
Error	2262.875	6	377.146		
Total	18457.000	16			

a. R Squared = .877 (Adjusted R Squared = .673)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.50	13.732	1.000	-48.04	47.04
	3	9.00	13.732	.910	-38.54	56.54
	4	23.25	13.732	.402	-24.29	70.79
2	1	.50	13.732	1.000	-47.04	48.04
	3	9.50	13.732	.897	-38.04	57.04
	4	23.75	13.732	.387	-23.79	71.29
3	1	-9.00	13.732	.910	-56.54	38.54
	2	-9.50	13.732	.897	-57.04	38.04
	4	14.25	13.732	.736	-33.29	61.79
4	1	-23.25	13.732	.402	-70.79	24.29
	2	-23.75	13.732	.387	-71.29	23.79
	3	-14.25	13.732	.736	-61.79	33.29

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Day	N	Subset 1
4	4	9.25
3	4	23.50
1	4	32.50
2	4	33.00
Sig.		.387

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 377.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	30.25	13.732	.225	-17.29	77.79
	C	28.25	13.732	.267	-19.29	75.79
	D	32.25	13.732	.189	-15.29	79.79
B	A	-30.25	13.732	.225	-77.79	17.29
	C	-2.00	13.732	.999	-49.54	45.54
	D	2.00	13.732	.999	-45.54	49.54
C	A	-28.25	13.732	.267	-75.79	19.29
	B	2.00	13.732	.999	-45.54	49.54
	D	4.00	13.732	.991	-43.54	51.54
D	A	-32.25	13.732	.189	-79.79	15.29
	B	-2.00	13.732	.999	-49.54	45.54
	C	-4.00	13.732	.991	-51.54	43.54

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Site	N	Subset 1
D	4	15.00
B	4	17.00
C	4	19.00
A	4	47.25
Sig.		.189

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 377.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Ancrucians

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	20.25	13.732	.504	-27.29	67.79
	3	-7.00	13.732	.954	-54.54	40.54
	4	19.50	13.732	.532	-28.04	67.04
2	1	-20.25	13.732	.504	-67.79	27.29
	3	-27.25	13.732	.290	-74.79	20.29
	4	-.75	13.732	1.000	-48.29	46.79
3	1	7.00	13.732	.954	-40.54	54.54
	2	27.25	13.732	.290	-20.29	74.79
	4	26.50	13.732	.309	-21.04	74.04
4	1	-19.50	13.732	.532	-67.04	28.04
	2	.75	13.732	1.000	-46.79	48.29
	3	-26.50	13.732	.309	-74.04	21.04

Based on observed means.

Homogeneous Subsets

Ancrucians

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	12.50
4	4	13.25
1	4	32.75
3	4	39.75
Sig.		.290

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 377.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Anopheles

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	22301.625[a]	10	2230.162	5.526	.024
Day	2526.687	3	842.229	2.087	.203
Site	3783.687	3	1261.229	3.125	.109
Treatment	2008.187	3	669.396	1.659	.273
Error	2421.375	6	403.563		
Total	24723.000	16			

a. R Squared = .902 (Adjusted R Squared = .739)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	6.50	14.205	.966	-42.67	55.67
	3	17.00	14.205	.650	-32.17	66.17
	4	33.25	14.205	.190	-15.92	82.42
2	1	-6.50	14.205	.966	-55.67	42.67
	3	10.50	14.205	.878	-38.67	59.67
	4	26.75	14.205	.326	-22.42	75.92
3	1	-17.00	14.205	.650	-66.17	32.17
	2	-10.50	14.205	.878	-59.67	38.67
	4	16.25	14.205	.679	-32.92	65.42
4	1	-33.25	14.205	.190	-82.42	15.92
	2	-26.75	14.205	.326	-75.92	22.42
	3	-16.25	14.205	.679	-65.42	32.92

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Day	N	Subset 1
4	4	10.50
3	4	26.75
2	4	37.25
1	4	43.75
Sig.		.190

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 403.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	36.25	14.205	.148	-12.92	85.42
	C	32.25	14.205	.207	-16.92	81.42
	D	37.25	14.205	.136	-11.92	86.42
B	A	-36.25	14.205	.148	-85.42	12.92
	C	-4.00	14.205	.991	-53.17	45.17
	D	1.00	14.205	1.000	-48.17	50.17
C	A	-32.25	14.205	.207	-81.42	16.92
	B	4.00	14.205	.991	-45.17	53.17
	D	5.00	14.205	.984	-44.17	54.17
D	A	-37.25	14.205	.136	-86.42	11.92
	B	-1.00	14.205	1.000	-50.17	48.17
	C	-5.00	14.205	.984	-54.17	44.17

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Site	N	Subset 1
D	4	18.75
B	4	19.75
C	4	23.75
A	4	56.00
Sig.		.136

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 403.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Anopheles

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	19.25	14.205	.566	-29.92	68.42
	3	-8.50	14.205	.929	-57.67	40.67
	4	15.00	14.205	.726	-34.17	64.17
2	1	-19.25	14.205	.566	-68.42	29.92
	3	-27.75	14.205	.301	-76.92	21.42
	4	-4.25	14.205	.990	-53.42	44.92
3	1	8.50	14.205	.929	-40.67	57.67
	2	27.75	14.205	.301	-21.42	76.92
	4	23.50	14.205	.419	-25.67	72.67
4	1	-15.00	14.205	.726	-64.17	34.17
	2	4.25	14.205	.990	-44.92	53.42
	3	-23.50	14.205	.419	-72.67	25.67

Based on observed means.

Homogeneous Subsets

Anopheles

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	16.75
4	4	21.00
1	4	36.00
3	4	44.50
Sig.		.301

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 403.563.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Anvesti

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	12.000[a]	10	1.200	1.800	.244
Day	2.250	3	.750	1.125	.411
Site	.250	3	.083	.125	.942
Treatment	3.250	3	1.083	1.625	.280
Error	4.000	6	.667		
Total	16.000	16			

a. R Squared = .750 (Adjusted R Squared = .333)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.75	.577	.595	-2.75	1.25
	3	-1.00	.577	.386	-3.00	1.00
	4	-.75	.577	.595	-2.75	1.25
2	1	.75	.577	.595	-1.25	2.75
	3	-.25	.577	.971	-2.25	1.75
	4	.00	.577	1.000	-2.00	2.00
3	1	1.00	.577	.386	-1.00	3.00
	2	.25	.577	.971	-1.75	2.25
	4	.25	.577	.971	-1.75	2.25
4	1	.75	.577	.595	-1.25	2.75
	2	.00	.577	1.000	-2.00	2.00
	3	-.25	.577	.971	-2.25	1.75

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Day	N	Subset 1
1	4	.00
2	4	.75
4	4	.75
3	4	1.00
Sig.		.386

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-.25	.577	.971	-2.25	1.75
	C	.00	.577	1.000	-2.00	2.00
	D	-.25	.577	.971	-2.25	1.75
B	A	.25	.577	.971	-1.75	2.25
	C	.25	.577	.971	-1.75	2.25
	D	.00	.577	1.000	-2.00	2.00
C	A	.00	.577	1.000	-2.00	2.00
	B	-.25	.577	.971	-2.25	1.75
	D	-.25	.577	.971	-2.25	1.75
D	A	.25	.577	.971	-1.75	2.25
	B	.00	.577	1.000	-2.00	2.00
	C	.25	.577	.971	-1.75	2.25

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Site	N	Subset 1
A	4	.50
C	4	.50
B	4	.75
D	4	.75
Sig.		.971

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Anvesti

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.50	.577	.822	-2.50	1.50
	3	-1.25	.577	.235	-3.25	.75
	4	-.75	.577	.595	-2.75	1.25
2	1	.50	.577	.822	-1.50	2.50
	3	-.75	.577	.595	-2.75	1.25
	4	-.25	.577	.971	-2.25	1.75
3	1	1.25	.577	.235	-.75	3.25
	2	.75	.577	.595	-1.25	2.75
	4	.50	.577	.822	-1.50	2.50
4	1	.75	.577	.595	-1.25	2.75
	2	.25	.577	.971	-1.75	2.25
	3	-.50	.577	.822	-2.50	1.50

Based on observed means.

Homogeneous Subsets

Anvesti

Tukey HSD[a,b]

Treatment	N	Subset 1
1	4	.00
2	4	.50
4	4	.75
3	4	1.25
Sig.		.235

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Coqnigricans

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	5784.000[a]	10	578.400	4.874	.033
Day	1056.500	3	352.167	2.968	.119
Site	528.500	3	176.167	1.485	.311
Treatment	230.000	3	76.667	.646	.613
Error	712.000	6	118.667		
Total	6496.000	16			

a. R Squared = .890 (Adjusted R Squared = .708)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.75	7.703	1.000	-27.41	25.91
	3	-14.00	7.703	.351	-40.66	12.66
	4	8.75	7.703	.683	-17.91	35.41
2	1	.75	7.703	1.000	-25.91	27.41
	3	-13.25	7.703	.391	-39.91	13.41
	4	9.50	7.703	.631	-17.16	36.16
3	1	14.00	7.703	.351	-12.66	40.66
	2	13.25	7.703	.391	-13.41	39.91
	4	22.75	7.703	.091	-3.91	49.41
4	1	-8.75	7.703	.683	-35.41	17.91
	2	-9.50	7.703	.631	-36.16	17.16
	3	-22.75	7.703	.091	-49.41	3.91

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Day	N	Subset 1
4	4	5.50
1	4	14.25
2	4	15.00
3	4	28.25
Sig.		.091

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	10.00	7.703	.596	-16.66	36.66
	C	9.25	7.703	.648	-17.41	35.91
	D	-3.25	7.703	.973	-29.91	23.41
B	A	-10.00	7.703	.596	-36.66	16.66
	C	-.75	7.703	1.000	-27.41	25.91
	D	-13.25	7.703	.391	-39.91	13.41
C	A	-9.25	7.703	.648	-35.91	17.41
	B	.75	7.703	1.000	-25.91	27.41
	D	-12.50	7.703	.434	-39.16	14.16
D	A	3.25	7.703	.973	-23.41	29.91
	B	13.25	7.703	.391	-13.41	39.91
	C	12.50	7.703	.434	-14.16	39.16

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Site	N	Subset 1
B	4	9.75
C	4	10.50
A	4	19.75
D	4	23.00
Sig.		.391

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Coqnigricans

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	5.50	7.703	.888	-21.16	32.16
	3	9.00	7.703	.666	-17.66	35.66
	4	9.50	7.703	.631	-17.16	36.16
2	1	-5.50	7.703	.888	-32.16	21.16
	3	3.50	7.703	.966	-23.16	30.16
	4	4.00	7.703	.951	-22.66	30.66
3	1	-9.00	7.703	.666	-35.66	17.66
	2	-3.50	7.703	.966	-30.16	23.16
	4	.50	7.703	1.000	-26.16	27.16
4	1	-9.50	7.703	.631	-36.16	17.16
	2	-4.00	7.703	.951	-30.66	22.66
	3	-.50	7.703	1.000	-27.16	26.16

Based on observed means.

Homogeneous Subsets

Coqnigricans

Tukey HSD[a,b]

Treatment	N	Subset 1
4	4	12.25
3	4	12.75
2	4	16.25
1	4	21.75
Sig.		.631

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Culicines

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	15231.000[a]	10	1523.100	5.392	.026
Day	452.000	3	150.667	.533	.676
Site	213.000	3	71.000	.251	.858
Treatment	166.000	3	55.333	.196	.896
Error	1695.000	6	282.500		
Total	16926.000	16			

a. R Squared = .900 (Adjusted R Squared = .733)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	1.00	11.885	1.000	-40.14	42.14
	3	-12.00	11.885	.750	-53.14	29.14
	4	-7.00	11.885	.932	-48.14	34.14
2	1	-1.00	11.885	1.000	-42.14	40.14
	3	-13.00	11.885	.706	-54.14	28.14
	4	-8.00	11.885	.904	-49.14	33.14
3	1	12.00	11.885	.750	-29.14	53.14
	2	13.00	11.885	.706	-28.14	54.14
	4	5.00	11.885	.973	-36.14	46.14
4	1	7.00	11.885	.932	-34.14	48.14
	2	8.00	11.885	.904	-33.14	49.14
	3	-5.00	11.885	.973	-46.14	36.14

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Day	N	Subset 1
2	4	24.50
1	4	25.50
4	4	32.50
3	4	37.50
Sig.		.706

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	6.50	11.885	.944	-34.64	47.64
	C	5.00	11.885	.973	-36.14	46.14
	D	-2.50	11.885	.996	-43.64	38.64
B	A	-6.50	11.885	.944	-47.64	34.64
	C	-1.50	11.885	.999	-42.64	39.64
	D	-9.00	11.885	.871	-50.14	32.14
C	A	-5.00	11.885	.973	-46.14	36.14
	B	1.50	11.885	.999	-39.64	42.64
	D	-7.50	11.885	.918	-48.64	33.64
D	A	2.50	11.885	.996	-38.64	43.64
	B	9.00	11.885	.871	-32.14	50.14
	C	7.50	11.885	.918	-33.64	48.64

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Site	N	Subset 1
B	4	25.75
C	4	27.25
A	4	32.25
D	4	34.75
Sig.		.871

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Culicines

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	8.50	11.885	.888	-32.64	49.64
	3	7.00	11.885	.932	-34.14	48.14
	4	4.50	11.885	.980	-36.64	45.64
2	1	-8.50	11.885	.888	-49.64	32.64
	3	-1.50	11.885	.999	-42.64	39.64
	4	-4.00	11.885	.986	-45.14	37.14
3	1	-7.00	11.885	.932	-48.14	34.14
	2	1.50	11.885	.999	-39.64	42.64
	4	-2.50	11.885	.996	-43.64	38.64
4	1	-4.50	11.885	.980	-45.64	36.64
	2	4.00	11.885	.986	-37.14	45.14
	3	2.50	11.885	.996	-38.64	43.64

Based on observed means.

Homogeneous Subsets

Culicines

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	26.50
3	4	28.00
4	4	30.50
1	4	35.00
Sig.		.888

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Univariate Analysis of Variance

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Tests of Between-Subjects Effects

Dependent Variable: Cxculex

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	402.500[a]	10	40.250	3.475	.070
Day	234.750	3	78.250	6.755	.024
Site	40.250	3	13.417	1.158	.400
Treatment	17.250	3	5.750	.496	.698
Error	69.500	6	11.583		
Total	472.000	16			

a. R Squared = .853 (Adjusted R Squared = .607)

Post Hoc Tests
Day

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.50	2.407	.996	-7.83	8.83
	3	.50	2.407	.996	-7.83	8.83
	4	-8.50*	2.407	.046	-16.83	-.17
2	1	-.50	2.407	.996	-8.83	7.83
	3	.00	2.407	1.000	-8.33	8.33
	4	-9.00*	2.407	.036	-17.33	-.67
3	1	-.50	2.407	.996	-8.83	7.83
	2	.00	2.407	1.000	-8.33	8.33
	4	-9.00*	2.407	.036	-17.33	-.67
4	1	8.50*	2.407	.046	.17	16.83
	2	9.00*	2.407	.036	.67	17.33
	3	9.00*	2.407	.036	.67	17.33

Based on observed means.

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Day	N	Subset	
		1	2
2	4	.25	
3	4	.25	
1	4	.75	
4	4		9.25
Sig.		.996	1.000

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Site

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-.75	2.407	.988	-9.08	7.58
	C	-4.00	2.407	.416	-12.33	4.33
	D	-2.75	2.407	.680	-11.08	5.58
B	A	.75	2.407	.988	-7.58	9.08
	C	-3.25	2.407	.568	-11.58	5.08
	D	-2.00	2.407	.838	-10.33	6.33
C	A	4.00	2.407	.416	-4.33	12.33
	B	3.25	2.407	.568	-5.08	11.58
	D	1.25	2.407	.951	-7.08	9.58
D	A	2.75	2.407	.680	-5.58	11.08
	B	2.00	2.407	.838	-6.33	10.33
	C	-1.25	2.407	.951	-9.58	7.08

Based on observed means.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Site	N	Subset 1
A	4	.75
B	4	1.50
D	4	3.50
C	4	4.75
Sig.		.416

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

Treatment

Multiple Comparisons

Dependent Variable: Cxculex

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2.25	2.407	.789	-6.08	10.58
	3	1.50	2.407	.921	-6.83	9.83
	4	-.25	2.407	1.000	-8.58	8.08
2	1	-2.25	2.407	.789	-10.58	6.08
	3	-.75	2.407	.988	-9.08	7.58
	4	-2.50	2.407	.735	-10.83	5.83
3	1	-1.50	2.407	.921	-9.83	6.83
	2	.75	2.407	.988	-7.58	9.08
	4	-1.75	2.407	.883	-10.08	6.58
4	1	.25	2.407	1.000	-8.08	8.58
	2	2.50	2.407	.735	-5.83	10.83
	3	1.75	2.407	.883	-6.58	10.08

Based on observed means.

Homogeneous Subsets

Cxculex

Tukey HSD[a,b]

Treatment	N	Subset 1
2	4	1.25
3	4	2.00
1	4	3.50
4	4	3.75
Sig.		.735

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

General Linear Model

Between-Subjects Factors

		N
Day	1	4
	2	4
	3	4
	4	4
Site	A	4
	B	4
	C	4
	D	4
Treatment	1	4
	2	4
	3	4
	4	4

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Day	Pillai's Trace	2.585	3.113	18.000	9.000	.043
	Wilks' Lambda	.002	1.595	18.000	3.314	.378
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	17.587	8.794[a]	6.000	3.000	.051
Site	Pillai's Trace	1.896	.859	18.000	9.000	.628
	Wilks' Lambda	.010	.745	18.000	3.314	.708
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	23.742	11.871[a]	6.000	3.000	.034
Treatment	Pillai's Trace	1.761	.711	18.000	9.000	.744
	Wilks' Lambda	.034	.426	18.000	3.314	.898
	Hotelling's Trace	.	.	18.000	.	.
	Roy's Largest Root	7.634	3.817[a]	6.000	3.000	.149

a. The statistic is an upper bound on F that yields a lower bound on the significance level.

b. Design: Day+Site+Treatment

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	Analbi	1262.000[a]	10	126.200	3.350	.076
	Ancrucians	19460.125[b]	10	1946.013	3.343	.076
	Anvesti	12.000[c]	10	1.200	1.800	.244
	Anopheles	28579.625[d]	10	2857.962	3.269	.080
	Coqnigricans	5784.000[e]	10	578.400	4.874	.033
	Mantitillans	1718.500[f]	10	171.850	3.248	.081
	Cxculex	402.500[g]	10	40.250	3.475	.070
	Aetaen	264.625[h]	10	26.463	1.465	.332
	Culicines	15231.000[i]	10	1523.100	5.392	.026
Day	Analbi	578.500	3	192.833	5.119	.043
	Ancrucians	2540.688	3	846.896	1.455	.318
	Anvesti	2.250	3	.750	1.125	.411
	Anopheles	5006.687	3	1668.896	1.909	.229
	Coqnigricans	1056.500	3	352.167	2.968	.119
	Mantitillans	14.750	3	4.917	.093	.961
	Cxculex	234.750	3	78.250	6.755	.024
	Aetaen	117.187	3	39.062	2.163	.194
	Culicines	452.000	3	150.667	.533	.676
Site	Analbi	126.000	3	42.000	1.115	.414
	Ancrucians	4012.187	3	1337.396	2.297	.178
	Anvesti	.250	3	.083	.125	.942
	Anopheles	4853.187	3	1617.729	1.850	.239
	Coqnigricans	528.500	3	176.167	1.485	.311
	Mantitillans	24.750	3	8.250	.156	.922
	Cxculex	40.250	3	13.417	1.158	.400
	Aetaen	54.188	3	18.063	1.000	.455
	Culicines	213.000	3	71.000	.251	.858
Treatment	Analbi	73.500	3	24.500	.650	.611
	Ancrucians	971.687	3	323.896	.556	.663
	Anvesti	3.250	3	1.083	1.625	.280
	Anopheles	830.687	3	276.896	.317	.813
	Coqnigricans	230.000	3	76.667	.646	.613
	Mantitillans	38.750	3	12.917	.244	.863
	Cxculex	17.250	3	5.750	.496	.698
	Aetaen	54.187	3	18.062	1.000	.455
	Culicines	166.000	3	55.333	.196	.896
Error	Analbi	226.000	6	37.667		
	Ancrucians	3492.875	6	582.146		
	Anvesti	4.000	6	.667		
	Anopheles	5245.375	6	874.229		
	Coqnigricans	712.000	6	118.667		
	Mantitillans	317.500	6	52.917		
	Cxculex	69.500	6	11.583		
	Aetaen	108.375	6	18.063		
	Culicines	1695.000	6	282.500		
Total	Analbi	1488.000	16			
	Ancrucians	22953.000	16			
	Anvesti	16.000	16			
	Anopheles	33825.000	16			
	Coqnigricans	6496.000	16			
	Mantitillans	2036.000	16			
	Cxculex	472.000	16			
	Aetaen	373.000	16			
	Culicines	16926.000	16			

a. R Squared = .848 (Adjusted R Squared = .595)

b. R Squared = .848 (Adjusted R Squared = .594)

c. R Squared = .750 (Adjusted R Squared = .333)

d. R Squared = .845 (Adjusted R Squared = .586)

e. R Squared = .890 (Adjusted R Squared = .708)

f. R Squared = .844 (Adjusted R Squared = .584)

g. R Squared = .853 (Adjusted R Squared = .607)

h. R Squared = .709 (Adjusted R Squared = .225)

Post Hoc Tests
Day

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Day	(J) Day	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	1	2	12.25	4.340	.106	-2.77	27.27
		3	13.50	4.340	.075	-1.52	28.52
		4	15.25*	4.340	.047	.23	30.27
	2	1	-12.25	4.340	.106	-27.27	2.77
		3	1.25	4.340	.991	-13.77	16.27
		4	3.00	4.340	.897	-12.02	18.02
	3	1	-13.50	4.340	.075	-28.52	1.52
		2	-1.25	4.340	.991	-16.27	13.77
		4	1.75	4.340	.976	-13.27	16.77
	4	1	-15.25*	4.340	.047	-30.27	-.23
		2	-3.00	4.340	.897	-18.02	12.02
		3	-1.75	4.340	.976	-16.77	13.27
Ancrucians	1	2	10.50	17.061	.923	-48.56	69.56
		3	20.00	17.061	.664	-39.06	79.06
		4	34.25	17.061	.282	-24.81	93.31
	2	1	-10.50	17.061	.923	-69.56	48.56
		3	9.50	17.061	.941	-49.56	68.56
		4	23.75	17.061	.547	-35.31	82.81
	3	1	-20.00	17.061	.664	-79.06	39.06
		2	-9.50	17.061	.941	-68.56	49.56
		4	14.25	17.061	.836	-44.81	73.31
	4	1	-34.25	17.061	.282	-93.31	24.81
		2	-23.75	17.061	.547	-82.81	35.31
		3	-14.25	17.061	.836	-73.31	44.81
Anvesti	1	2	-.75	.577	.595	-2.75	1.25
		3	-1.00	.577	.386	-3.00	1.00
		4	-.75	.577	.595	-2.75	1.25
	2	1	.75	.577	.595	-1.25	2.75
		3	-.25	.577	.971	-2.25	1.75
		4	.00	.577	1.000	-2.00	2.00
	3	1	1.00	.577	.386	-1.00	3.00
		2	.25	.577	.971	-1.75	2.25
		4	.25	.577	.971	-1.75	2.25
	4	1	.75	.577	.595	-1.25	2.75
		2	.00	.577	1.000	-2.00	2.00
		3	-.25	.577	.971	-2.25	1.75
Anopheles	1	2	22.00	20.907	.728	-50.37	94.37
		3	32.50	20.907	.465	-39.87	104.87
		4	48.75	20.907	.192	-23.62	121.12
	2	1	-22.00	20.907	.728	-94.37	50.37
		3	10.50	20.907	.956	-61.87	82.87
		4	26.75	20.907	.606	-45.62	99.12
	3	1	-32.50	20.907	.465	-104.87	39.87
		2	-10.50	20.907	.956	-82.87	61.87
		4	16.25	20.907	.862	-56.12	88.62
	4	1	-48.75	20.907	.192	-121.12	23.62
		2	-26.75	20.907	.606	-99.12	45.62
		3	-16.25	20.907	.862	-88.62	56.12
Coqnigricans	1	2	-.75	7.703	1.000	-27.41	25.91
		3	-14.00	7.703	.351	-40.66	12.66
		4	8.75	7.703	.683	-17.91	35.41
	2	1	.75	7.703	1.000	-25.91	27.41
		3	-13.25	7.703	.391	-39.91	13.41
		4	9.50	7.703	.631	-17.16	36.16
	3	1	14.00	7.703	.351	-12.66	40.66
		2	13.25	7.703	.391	-13.41	39.91
		4	22.75	7.703	.091	-3.91	49.41
	4	1	-8.75	7.703	.683	-35.41	17.91
		2	-9.50	7.703	.631	-36.16	17.16
		3	-22.75	7.703	.091	-49.41	3.91
Mantitillans	1	2	1.00	5.144	.997	-16.81	18.81
		3	1.50	5.144	.990	-16.31	19.31
		4	-1.00	5.144	.997	-18.81	16.81
	2	1	-1.00	5.144	.997	-18.81	16.81
		3	.50	5.144	1.000	-17.31	18.31
		4	-2.00	5.144	.978	-19.81	15.81
	3	1	-1.50	5.144	.990	-19.31	16.31
		2	-.50	5.144	1.000	-18.31	17.31
		4	-2.50	5.144	.959	-20.31	15.31
	4	1	1.00	5.144	.997	-16.81	18.81
		2	2.00	5.144	.978	-15.81	19.81
		3	2.50	5.144	.959	-15.31	20.31
Cxculex	1	2	.50	2.407	.996	-7.83	8.83
		3	.50	2.407	.996	-7.83	8.83
		4	-8.50*	2.407	.046	-16.83	-.17
	2	1	-.50	2.407	.996	-8.83	7.83
		3	.00	2.407	1.000	-8.33	8.33
		4	-9.00*	2.407	.036	-17.33	-.67
	3	1	-.50	2.407	.996	-8.83	7.83
		2	.00	2.407	1.000	-8.33	8.33
		4	-9.00*	2.407	.036	-17.33	-.67
	4	1	8.50*	2.407	.046	.17	16.83
		2	9.00*	2.407	.036	.67	17.33
		3	9.00*	2.407	.036	.67	17.33
Aetaen	1	2	.00	3.005	1.000	-10.40	10.40
		3	.00	3.005	1.000	-10.40	10.40
		4	-6.25	3.005	.260	-16.65	4.15
	2	1	.00	3.005	1.000	-10.40	10.40
		3	.00	3.005	1.000	-10.40	10.40
		4	-6.25	3.005	.260	-16.65	4.15
	3	1	.00	3.005	1.000	-10.40	10.40
		2	.00	3.005	1.000	-10.40	10.40
		4	-6.25	3.005	.260	-16.65	4.15
	4	1	6.25	3.005	.260	-4.15	16.65
		2	6.25	3.005	.260	-4.15	16.65
		3	6.25	3.005	.260	-4.15	16.65
Culicines	1	2	1.00	11.885	1.000	-40.14	42.14
		3	-12.00	11.885	.750	-53.14	29.14
		[redacted]					
	2	1	-1.00	11.885	1.000	-42.14	40.14
		3	-13.00	11.885	.706	-54.14	28.14
		4	-8.00	11.885	.904	-49.14	33.14
	3	1	12.00	11.885	.750	-29.14	53.14

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Day	N	Subset 1	Subset 2
4	4	.50	
3	4	2.25	2.25
2	4	3.50	3.50
1	4		15.75
Sig.		.897	.075

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 37.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Day	N	Subset 1
4	4	9.25
3	4	23.50
2	4	33.00
1	4	43.50
Sig.		.282

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 582.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Day	N	Subset 1
1	4	.00
2	4	.75
4	4	.75
3	4	1.00
Sig.		.386

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Day	N	Subset 1
4	4	10.50
3	4	26.75
2	4	37.25
1	4	59.25
Sig.		.192

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 874.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Day	N	Subset 1
4	4	5.50
1	4	14.25
2	4	15.00
3	4	28.25
Sig.		.091

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Day	N	Subset 1
3	4	9.00
2	4	9.50
1	4	10.50
4	4	11.50
Sig.		.959

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 52.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Day	N	Subset 1	Subset 2
2	4	.25	
3	4	.25	
1	4	.75	
4	4		9.25
Sig.		.996	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Aetaen

Tukey HSD[a,b,c]

Day	N	Subset 1
1	4	.00
2	4	.00
3	4	.00
4	4	6.25
Sig.		.260

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Day	N	Subset 1
2	4	24.50
1	4	25.50
4	4	32.50
3	4	37.50
Sig.		.706

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Site

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Site	(J) Site	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	A	B	4.50	4.340	.736	-10.52	19.52
		C	-3.00	4.340	.897	-18.02	12.02
		D	2.50	4.340	.936	-12.52	17.52
	B	A	-4.50	4.340	.736	-19.52	10.52
		C	-7.50	4.340	.387	-22.52	7.52
		D	-2.00	4.340	.965	-17.02	13.02
	C	A	3.00	4.340	.897	-12.02	18.02
		B	7.50	4.340	.387	-7.52	22.52
		D	5.50	4.340	.612	-9.52	20.52
	D	A	-2.50	4.340	.936	-17.52	12.52
		B	2.00	4.340	.965	-13.02	17.02
		C	-5.50	4.340	.612	-20.52	9.52
Ancrucians	A	B	39.00	17.061	.203	-20.06	98.06
		C	24.25	17.061	.531	-34.81	83.31
		D	38.50	17.061	.211	-20.56	97.56
	B	A	-39.00	17.061	.203	-98.06	20.06
		C	-14.75	17.061	.823	-73.81	44.31
		D	-.50	17.061	1.000	-59.56	58.56
	C	A	-24.25	17.061	.531	-83.31	34.81
		B	14.75	17.061	.823	-44.31	73.81
		D	14.25	17.061	.836	-44.81	73.31
	D	A	-38.50	17.061	.211	-97.56	20.56
		B	.50	17.061	1.000	-58.56	59.56
		C	-14.25	17.061	.836	-73.31	44.81
Anvesti	A	B	-.25	.577	.971	-2.25	1.75
		C	.00	.577	1.000	-2.00	2.00
		D	-.25	.577	.971	-2.25	1.75
	B	A	.25	.577	.971	-1.75	2.25
		C	.25	.577	.971	-1.75	2.25
		D	.00	.577	1.000	-2.00	2.00
	C	A	.00	.577	1.000	-2.00	2.00
		B	-.25	.577	.971	-2.25	1.75
		D	-.25	.577	.971	-2.25	1.75
	D	A	.25	.577	.971	-1.75	2.25
		B	.00	.577	1.000	-2.00	2.00
		C	.25	.577	.971	-1.75	2.25
Anopheles	A	B	43.25	20.907	.263	-29.12	115.62
		C	21.25	20.907	.747	-51.12	93.62
		D	40.75	20.907	.302	-31.62	113.12
	B	A	-43.25	20.907	.263	-115.62	29.12
		C	-22.00	20.907	.728	-94.37	50.37
		D	-2.50	20.907	.999	-74.87	69.87
	C	A	-21.25	20.907	.747	-93.62	51.12
		B	22.00	20.907	.728	-50.37	94.37
		D	19.50	20.907	.790	-52.87	91.87
	D	A	-40.75	20.907	.302	-113.12	31.62
		B	2.50	20.907	.999	-69.87	74.87
		C	-19.50	20.907	.790	-91.87	52.87
Coqnigricans	A	B	10.00	7.703	.596	-16.66	36.66
		C	9.25	7.703	.648	-17.41	35.91
		D	-3.25	7.703	.973	-29.91	23.41
	B	A	-10.00	7.703	.596	-36.66	16.66
		C	-.75	7.703	1.000	-27.41	25.91
		D	-13.25	7.703	.391	-39.91	13.41
	C	A	-9.25	7.703	.648	-35.91	17.41
		B	.75	7.703	1.000	-25.91	27.41
		D	-12.50	7.703	.434	-39.16	14.16
	D	A	3.25	7.703	.973	-23.41	29.91
		B	13.25	7.703	.391	-13.41	39.91
		C	12.50	7.703	.434	-14.16	39.16
Mantitillans	A	B	1.50	5.144	.990	-16.31	19.31
		C	1.50	5.144	.990	-16.31	19.31
		D	3.50	5.144	.901	-14.31	21.31
	B	A	-1.50	5.144	.990	-19.31	16.31
		C	.00	5.144	1.000	-17.81	17.81
		D	2.00	5.144	.978	-15.81	19.81
	C	A	-1.50	5.144	.990	-19.31	16.31
		B	.00	5.144	1.000	-17.81	17.81
		D	2.00	5.144	.978	-15.81	19.81
	D	A	-3.50	5.144	.901	-21.31	14.31
		B	-2.00	5.144	.978	-19.81	15.81
		C	-2.00	5.144	.978	-19.81	15.81
Cxculex	A	B	-.75	2.407	.988	-9.08	7.58
		C	-4.00	2.407	.416	-12.33	4.33
		D	-2.75	2.407	.680	-11.08	5.58
	B	A	.75	2.407	.988	-7.58	9.08
		C	-3.25	2.407	.568	-11.58	5.08
		D	-2.00	2.407	.838	-10.33	6.33
	C	A	4.00	2.407	.416	-4.33	12.33
		B	3.25	2.407	.568	-5.08	11.58
		D	1.25	2.407	.951	-7.08	9.58
	D	A	2.75	2.407	.680	-5.58	11.08
		B	2.00	2.407	.838	-6.33	10.33
		C	-1.25	2.407	.951	-9.58	7.08
Aetaen	A	B	-4.50	3.005	.493	-14.90	5.90
		C	-1.75	3.005	.934	-12.15	8.65
		D	.00	3.005	1.000	-10.40	10.40
	B	A	4.50	3.005	.493	-5.90	14.90
		C	2.75	3.005	.798	-7.65	13.15
		D	4.50	3.005	.493	-5.90	14.90
	C	A	1.75	3.005	.934	-8.65	12.15
		B	-2.75	3.005	.798	-13.15	7.65
		D	1.75	3.005	.934	-8.65	12.15
	D	A	.00	3.005	1.000	-10.40	10.40
		B	-4.50	3.005	.493	-14.90	5.90
		C	-1.75	3.005	.934	-12.15	8.65
Culicines	A	B	6.50	11.885	.944	-34.64	47.64
		C	5.00	11.885	.973	-36.14	46.14
		[redacted]					
	B	A	-6.50	11.885	.944	-47.64	34.64
		C	-1.50	11.885	.999	-42.64	39.64
		D	-9.00	11.885	.871	-50.14	32.14
	C	A	-5.00	11.885	.973	-46.14	36.14

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	2.00
D	4	4.00
A	4	6.50
C	4	9.50
Sig.		.387

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 37.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	13.75
D	4	14.25
C	4	28.50
A	4	52.75
Sig.		.203

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 582.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Site	N	Subset 1
A	4	.50
C	4	.50
B	4	.75
D	4	.75
Sig.		.971

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	16.50
D	4	19.00
C	4	38.50
A	4	59.75
Sig.		.263

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 874.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	9.75
C	4	10.50
A	4	19.75
D	4	23.00
Sig.		.391

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Site	N	Subset 1
D	4	8.25
B	4	10.25
C	4	10.25
A	4	11.75
Sig.		.901

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 52.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Site	N	Subset 1
A	4	.75
B	4	1.50
D	4	3.50
C	4	4.75
Sig.		.416

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Aetaen

Tukey HSD[a,b,c]

Site	N	Subset 1
A	4	.00
D	4	.00
C	4	1.75
B	4	4.50
Sig.		.493

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Site	N	Subset 1
B	4	25.75
C	4	27.25
A	4	32.25
D	4	34.75
Sig.		.871

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Treatment

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Analbi	1	2	-5.75	4.340	.582	-20.77	9.27
		3	-1.25	4.340	.991	-16.27	13.77
		4	-2.00	4.340	.965	-17.02	13.02
	2	1	5.75	4.340	.582	-9.27	20.77
		3	4.50	4.340	.736	-10.52	19.52
		4	3.75	4.340	.823	-11.27	18.77
	3	1	1.25	4.340	.991	-13.77	16.27
		2	-4.50	4.340	.736	-19.52	10.52
		4	-.75	4.340	.998	-15.77	14.27
	4	1	2.00	4.340	.965	-13.02	17.02
		2	-3.75	4.340	.823	-18.77	11.27
		3	.75	4.340	.998	-14.27	15.77
Ancrucians	1	2	7.50	17.061	.969	-51.56	66.56
		3	-9.50	17.061	.941	-68.56	49.56
		4	10.75	17.061	.919	-48.31	69.81
	2	1	-7.50	17.061	.969	-66.56	51.56
		3	-17.00	17.061	.757	-76.06	42.06
		4	3.25	17.061	.997	-55.81	62.31
	3	1	9.50	17.061	.941	-49.56	68.56
		2	17.00	17.061	.757	-42.06	76.06
		4	20.25	17.061	.656	-38.81	79.31
	4	1	-10.75	17.061	.919	-69.81	48.31
		2	-3.25	17.061	.997	-62.31	55.81
		3	-20.25	17.061	.656	-79.31	38.81
Anvesti	1	2	-.50	.577	.822	-2.50	1.50
		3	-1.25	.577	.235	-3.25	.75
		4	-.75	.577	.595	-2.75	1.25
	2	1	.50	.577	.822	-1.50	2.50
		3	-.75	.577	.595	-2.75	1.25
		4	-.25	.577	.971	-2.25	1.75
	3	1	1.25	.577	.235	-.75	3.25
		2	.75	.577	.595	-1.25	2.75
		4	.50	.577	.822	-1.50	2.50
	4	1	.75	.577	.595	-1.25	2.75
		2	.25	.577	.971	-1.75	2.25
		3	-.50	.577	.822	-2.50	1.50
Anopheles	1	2	1.25	20.907	1.000	-71.12	73.62
		3	-12.00	20.907	.936	-84.37	60.37
		4	8.00	20.907	.979	-64.37	80.37
	2	1	-1.25	20.907	1.000	-73.62	71.12
		3	-13.25	20.907	.917	-85.62	59.12
		4	6.75	20.907	.987	-65.62	79.12
	3	1	12.00	20.907	.936	-60.37	84.37
		2	13.25	20.907	.917	-59.12	85.62
		4	20.00	20.907	.778	-52.37	92.37
	4	1	-8.00	20.907	.979	-80.37	64.37
		2	-6.75	20.907	.987	-79.12	65.62
		3	-20.00	20.907	.778	-92.37	52.37
Coqnigricans	1	2	5.50	7.703	.888	-21.16	32.16
		3	9.00	7.703	.666	-17.66	35.66
		4	9.50	7.703	.631	-17.16	36.16
	2	1	-5.50	7.703	.888	-32.16	21.16
		3	3.50	7.703	.966	-23.16	30.16
		4	4.00	7.703	.951	-22.66	30.66
	3	1	-9.00	7.703	.666	-35.66	17.66
		2	-3.50	7.703	.966	-30.16	23.16
		4	.50	7.703	1.000	-26.16	27.16
	4	1	-9.50	7.703	.631	-36.16	17.16
		2	-4.00	7.703	.951	-30.66	22.66
		3	-.50	7.703	1.000	-27.16	26.16
Mantitillans	1	2	.50	5.144	1.000	-17.31	18.31
		3	1.00	5.144	.997	-16.81	18.81
		4	-3.00	5.144	.934	-20.81	14.81
	2	1	-.50	5.144	1.000	-18.31	17.31
		3	.50	5.144	1.000	-17.31	18.31
		4	-3.50	5.144	.901	-21.31	14.31
	3	1	-1.00	5.144	.997	-18.81	16.81
		2	-.50	5.144	1.000	-18.31	17.31
		4	-4.00	5.144	.862	-21.81	13.81
	4	1	3.00	5.144	.934	-14.81	20.81
		2	3.50	5.144	.901	-14.31	21.31
		3	4.00	5.144	.862	-13.81	21.81
Cxculex	1	2	2.25	2.407	.789	-6.08	10.58
		3	1.50	2.407	.921	-6.83	9.83
		4	-.25	2.407	1.000	-8.58	8.08
	2	1	-2.25	2.407	.789	-10.58	6.08
		3	-.75	2.407	.988	-9.08	7.58
		4	-2.50	2.407	.735	-10.83	5.83
	3	1	-1.50	2.407	.921	-9.83	6.83
		2	.75	2.407	.988	-7.58	9.08
		4	-1.75	2.407	.883	-10.08	6.58
	4	1	.25	2.407	1.000	-8.08	8.58
		2	2.50	2.407	.735	-5.83	10.83
		3	1.75	2.407	.883	-6.58	10.08
Aetaen	1	2	.00	3.005	1.000	-10.40	10.40
		3	-4.50	3.005	.493	-14.90	5.90
		4	-1.75	3.005	.934	-12.15	8.65
	2	1	.00	3.005	1.000	-10.40	10.40
		3	-4.50	3.005	.493	-14.90	5.90
		4	-1.75	3.005	.934	-12.15	8.65
	3	1	4.50	3.005	.493	-5.90	14.90
		2	4.50	3.005	.493	-5.90	14.90
		4	2.75	3.005	.798	-7.65	13.15
	4	1	1.75	3.005	.934	-8.65	12.15
		2	1.75	3.005	.934	-8.65	12.15
		3	-2.75	3.005	.798	-13.15	7.65
Culicines	1	2	8.50	11.885	.888	-32.64	49.64
		3	7.00	11.885	.932	-34.14	48.14
		[redacted]					
	2	1	-8.50	11.885	.888	-49.64	32.64
		3	-1.50	11.885	.999	-42.64	39.64
		4	-4.00	11.885	.986	-45.14	37.14
	3	1	-7.00	11.885	.932	-48.14	34.14

Homogeneous Subsets

Analbi

Tukey HSD[a,b,c]

Treatment	N	Subset 1
1	4	3.25
3	4	4.50
4	4	5.25
2	4	9.00
Sig.		.582

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 37.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Ancrucians

Tukey HSD[a,b,c]

Treatment	N	Subset 1
4	4	18.75
2	4	22.00
1	4	29.50
3	4	39.00
Sig.		.656

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 582.146.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anvesti

Tukey HSD[a,b,c]

Treatment	N	Subset 1
1	4	.00
2	4	.50
4	4	.75
3	4	1.25
Sig.		.235

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Anopheles

Tukey HSD[a,b,c]

Treatment	N	Subset 1
4	4	24.75
2	4	31.50
1	4	32.75
3	4	44.75
Sig.		.778

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 874.229.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Coqnigricans

Tukey HSD[a,b,c]

Treatment	N	Subset 1
4	4	12.25
3	4	12.75
2	4	16.25
1	4	21.75
Sig.		.631

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 118.667.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mantitillans

Tukey HSD[a,b,c]

Treatment	N	Subset 1
3	4	8.75
2	4	9.25
1	4	9.75
4	4	12.75
Sig.		.862

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 52.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cxculex

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	1.25
3	4	2.00
1	4	3.50
4	4	3.75
Sig.		.735

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 11.583.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Aetaen

Tukey HSD[a,b,c]

Treatment	N	Subset 1
1	4	.00
2	4	.00
4	4	1.75
3	4	4.50
Sig.		.493

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 18.063.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Culicines

Tukey HSD[a,b,c]

Treatment	N	Subset 1
2	4	26.50
3	4	28.00
4	4	30.50
1	4	35.00
Sig.		.888

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 282.500.

a. Uses Harmonic Mean Sample Size = 4.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Kruskal Wallis Control Output

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Aetaen	1	4	8.50
	2	4	8.50
	3	4	8.50
	4	4	8.50
	Total	16	

Test Statistics(a,b)

	Aetaen
Chi-Square	.000
df	3
Asymp. Sig.	1.000

a Kruskal Wallis Test
b Grouping Variable: Treatment

Ranks

	Treatment	N	Mean Rank
Aetaen	1	4	8.50
	2	4	8.50
	3	4	8.50
	4	4	8.50
	Total	16	

Explore

Warnings

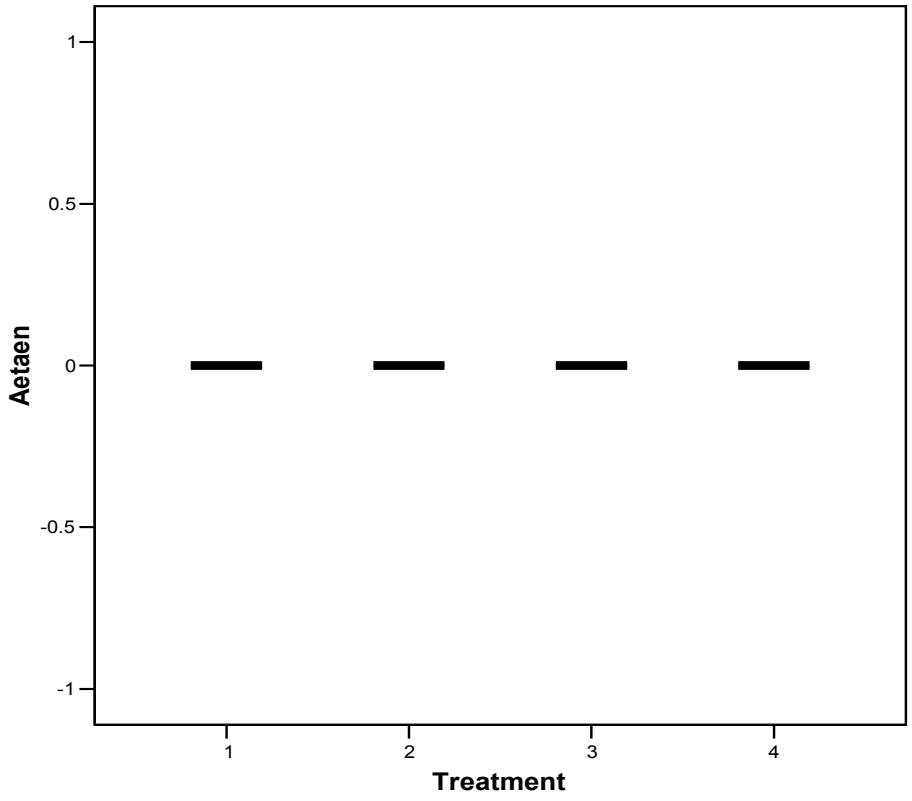
Aetaen is constant when Treatment = 1. It will be included in any boxplots produced but other output will be omitted.
Aetaen is constant when Treatment = 2. It will be included in any boxplots produced but other output will be omitted.
Aetaen is constant when Treatment = 3. It will be included in any boxplots produced but other output will be omitted.
Aetaen is constant when Treatment = 4. It will be included in any boxplots produced but other output will be omitted.

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Aetaen	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Aetaen



NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Analbi	1	4	7.50
	2	4	7.75
	3	4	9.75
	4	4	9.00
	Total	16	

Test Statistics(a,b)

	Analbi
Chi-Square	.599
df	3
Asymp. Sig.	.897

a Kruskal Wallis Test
b Grouping Variable: Treatment

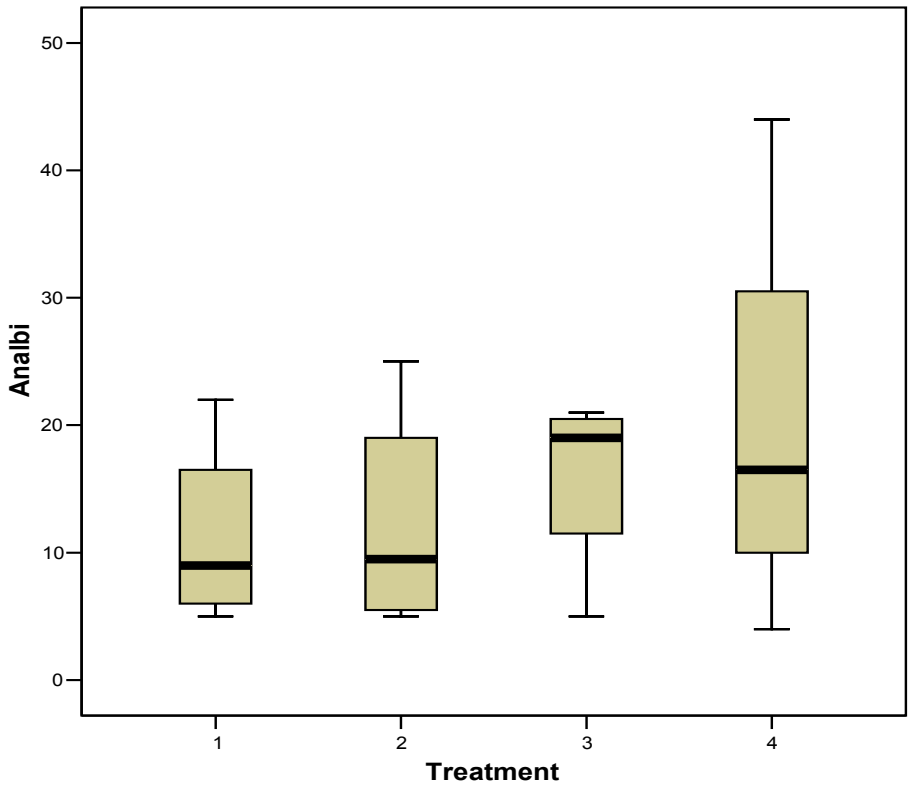
Explore

Treatment

Case Processing Summary

	Treatment	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
Analbi	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Analbi


50
40
30
20
10
0
Analbi
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Ancrucians	1	4	7.13
	2	4	8.00
	3	4	12.88
	4	4	6.00
	Total	16	

Test Statistics(a,b)

	Ancrucians
Chi-Square	4.866
df	3
Asymp. Sig.	.182

a Kruskal Wallis Test
b Grouping Variable: Treatment

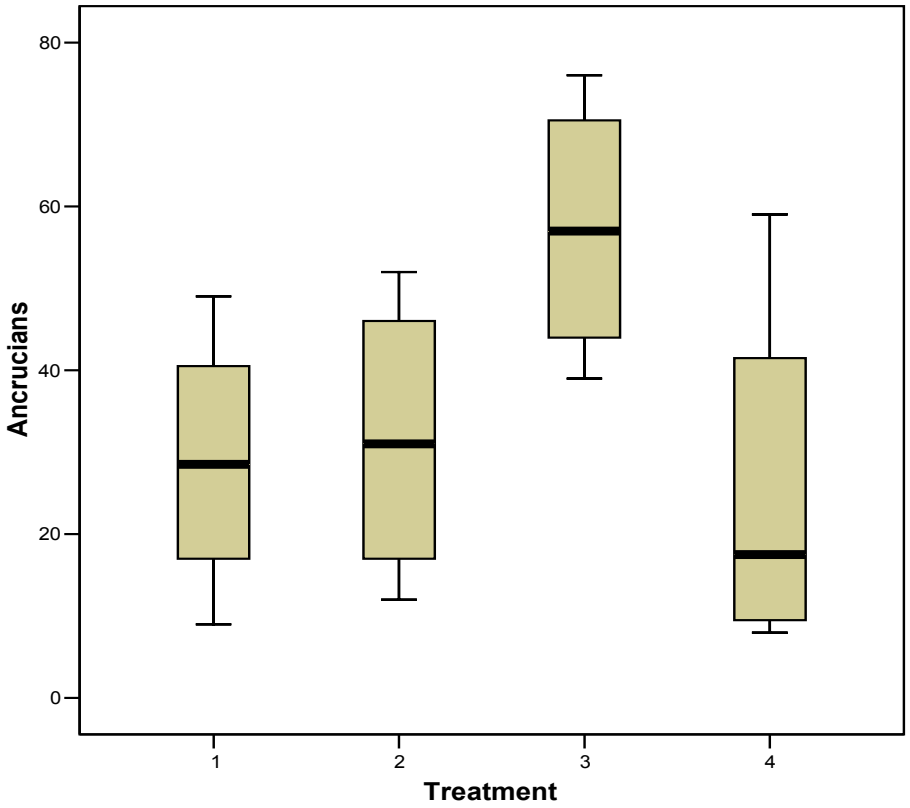
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Ancrucians	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Ancrucians


80
60
40
20
0
Ancrucians
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Anopheles	1	4	8.00
	2	4	5.25
	3	4	11.75
	4	4	9.00
	Total	16	

Test Statistics(a,b)

	Anopheles
Chi-Square	3.816
df	3
Asymp. Sig.	.282

a Kruskal Wallis Test
b Grouping Variable: Treatment

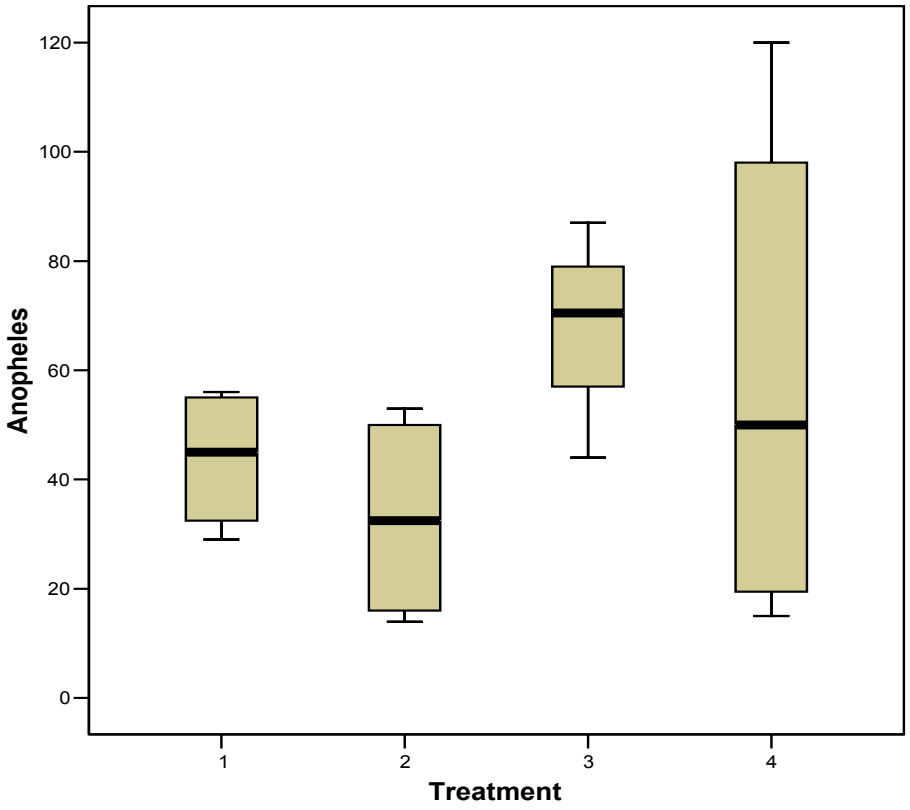
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Anopheles	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Anopheles


120
100
80
60
40
20
0
Anopheles
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Anvesti	1	4	7.50
	2	4	7.50
	3	4	11.50
	4	4	7.50
	Total	16	

Test Statistics(a,b)

	Anvesti
Chi-Square	6.400
df	3
Asymp. Sig.	.094

a Kruskal Wallis Test
b Grouping Variable: Treatment

Explore

Warnings

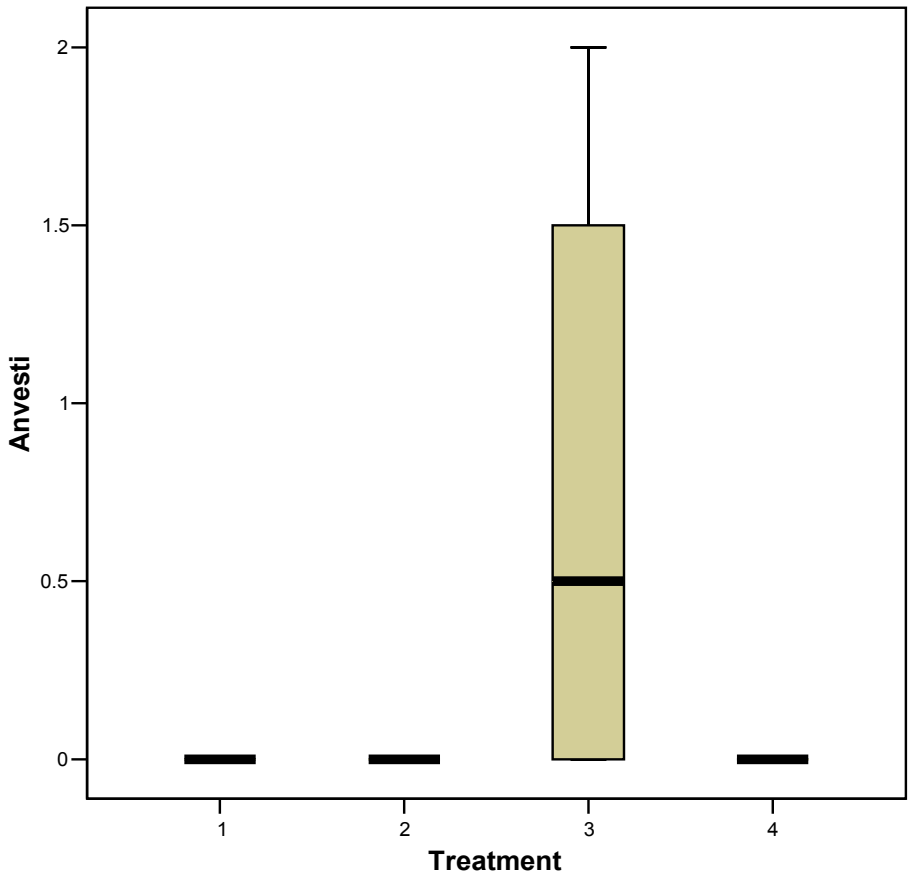
Anvesti is constant when Treatment = 1. It will be included in any boxplots produced but other output will be omitted.
Anvesti is constant when Treatment = 2. It will be included in any boxplots produced but other output will be omitted.
Anvesti is constant when Treatment = 4. It will be included in any boxplots produced but other output will be omitted.

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Anvesti	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Anvesti


Anvesti
2
1.5
1
0.5
0
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Coqnigricans	1	4	8.75
	2	4	4.75
	3	4	10.13
	4	4	10.38
	Total	16	

Test Statistics(a,b)

	Coqnigricans
Chi-Square	3.595
df	3
Asymp. Sig.	.309

a Kruskal Wallis Test
b Grouping Variable: Treatment

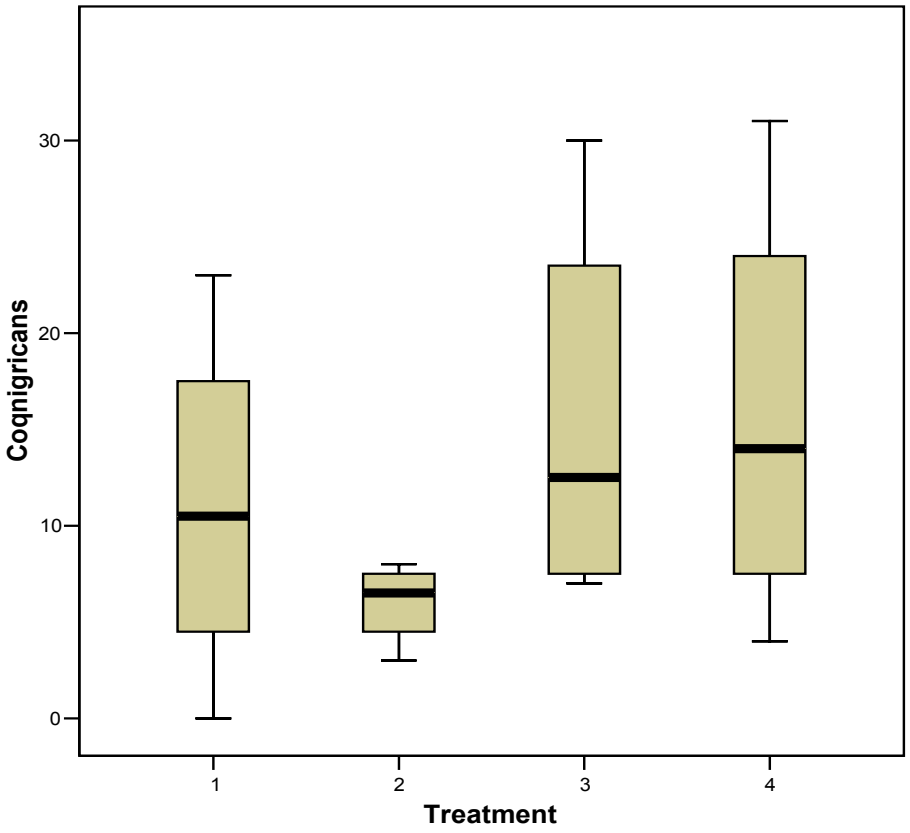
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Coqnigricans	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Coqnigricans


Coqnigricans
30
20
10
0
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Culicines	1	4	8.50
	2	4	5.25
	3	4	10.00
	4	4	10.25
	Total	16	

Test Statistics(a,b)

	Culicines
Chi-Square	2.801
df	3
Asymp. Sig.	.423

a Kruskal Wallis Test
b Grouping Variable: Treatment

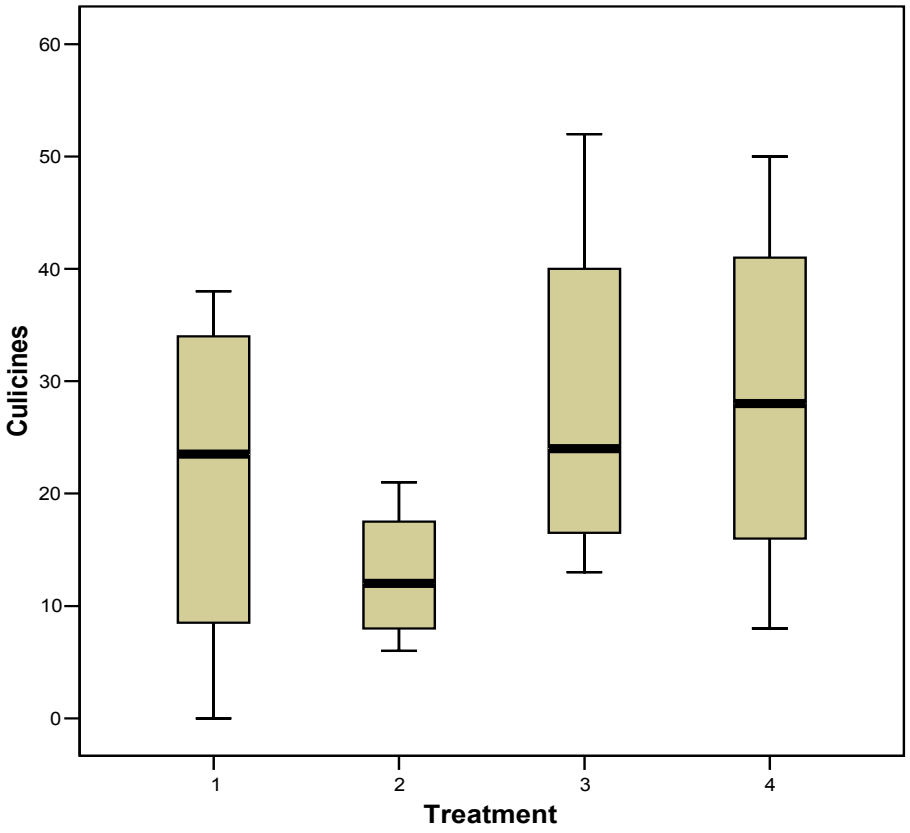
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Culicines	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Culicines


60
50
40
30
20
10
0
Culicines
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Cxculex	1	4	8.00
	2	4	7.75
	3	4	9.88
	4	4	8.38
	Total	16	

Test Statistics(a,b)

	Cxculex
Chi-Square	.510
df	3
Asymp. Sig.	.917

a Kruskal Wallis Test
b Grouping Variable: Treatment

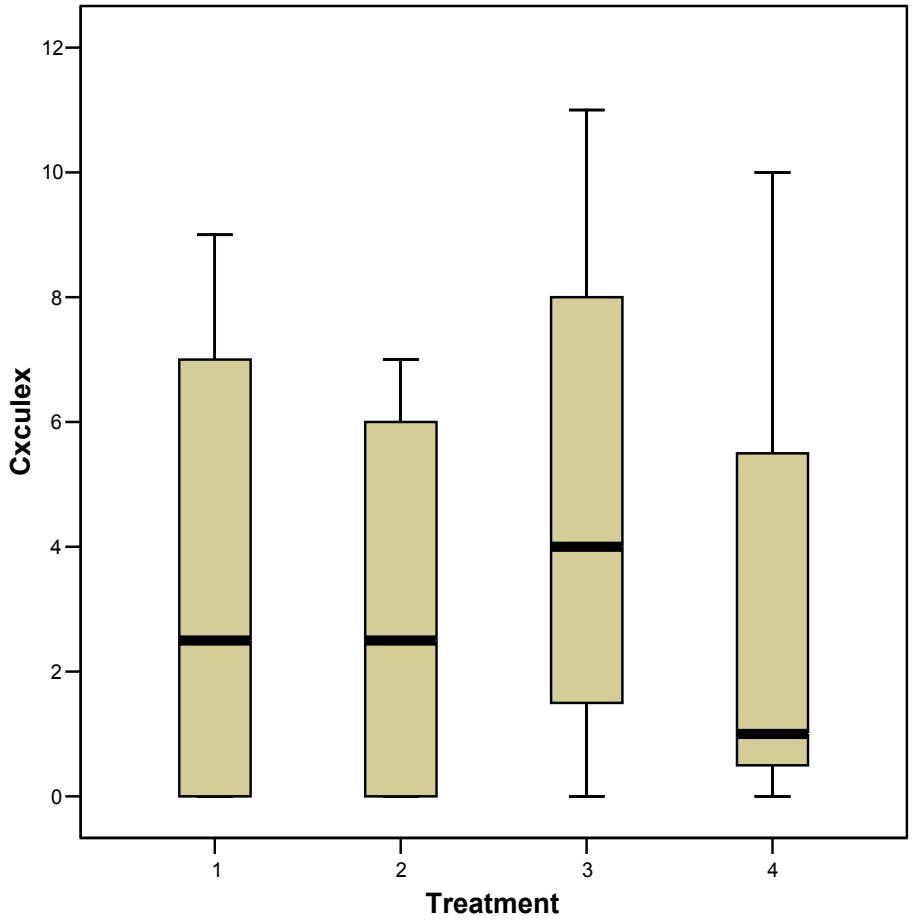
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Cxculex	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Cxculex


12
10
8
6
4
2
0
Cxculex
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Mantitillans	1	4	8.50
	2	4	5.88
	3	4	9.25
	4	4	10.38
	Total	16	

Test Statistics(a,b)

	Mantitillans
Chi-Square	1.959
df	3
Asymp. Sig.	.581

a Kruskal Wallis Test
b Grouping Variable: Treatment

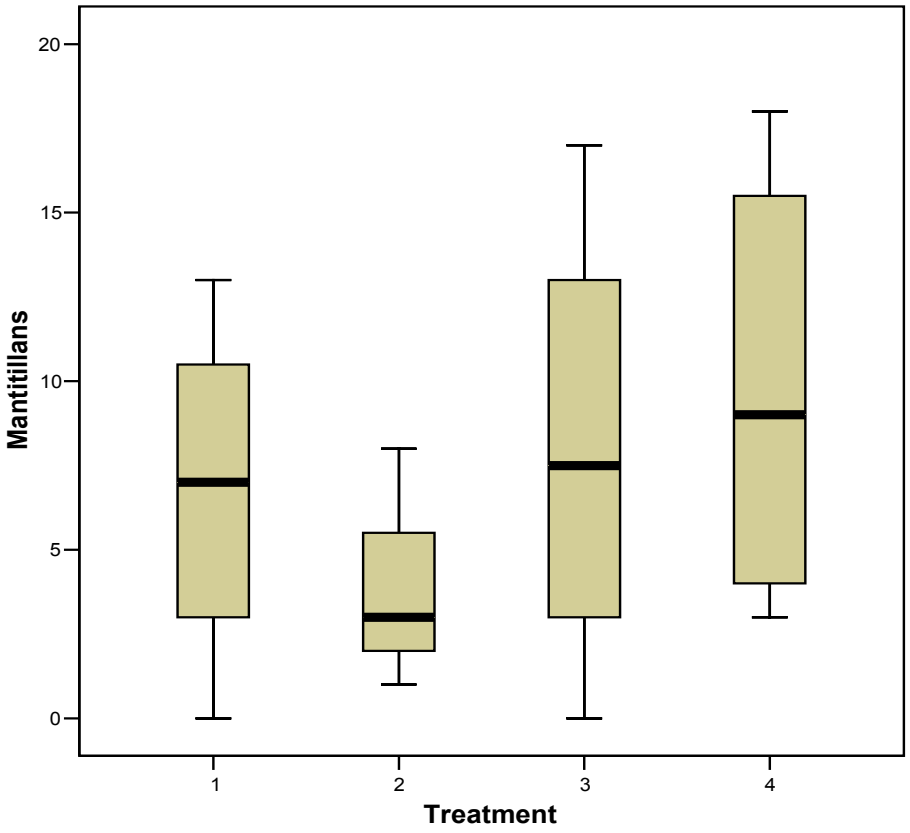
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Mantitillans	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Mantitillans


20
15
10
5
0
Mantitillans
1
2
3
4
Treatment

Kruskal Wallis Standard Output

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Aetaen	1	4	7.50
	2	4	7.50
	3	4	9.63
	4	4	9.38
	Total	16	

Test Statistics(a,b)

	Aetaen
Chi-Square	2.150
df	3
Asymp. Sig.	.542

a Kruskal Wallis Test
b Grouping Variable: Treatment

Explore

Warnings

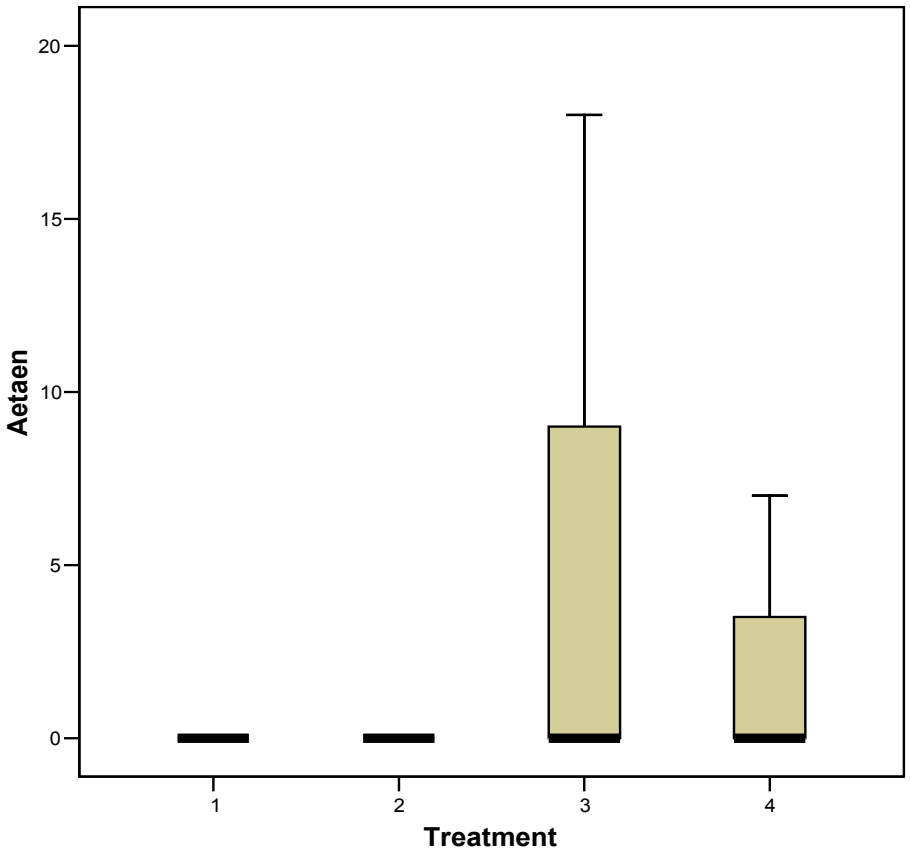
Aetaen is constant when Treatment = 1. It will be included in any boxplots produced but other output will be omitted.
Aetaen is constant when Treatment = 2. It will be included in any boxplots produced but other output will be omitted.

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Aetaen	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Aetaen


20
15
10
5
0
Aetaen
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Analbi	1	4	8.63
	2	4	8.00
	3	4	8.38
	4	4	9.00
	Total	16	

Test Statistics(a,b)

	Analbi
Chi-Square	.095
df	3
Asymp. Sig.	.992

a Kruskal Wallis Test
b Grouping Variable: Treatment

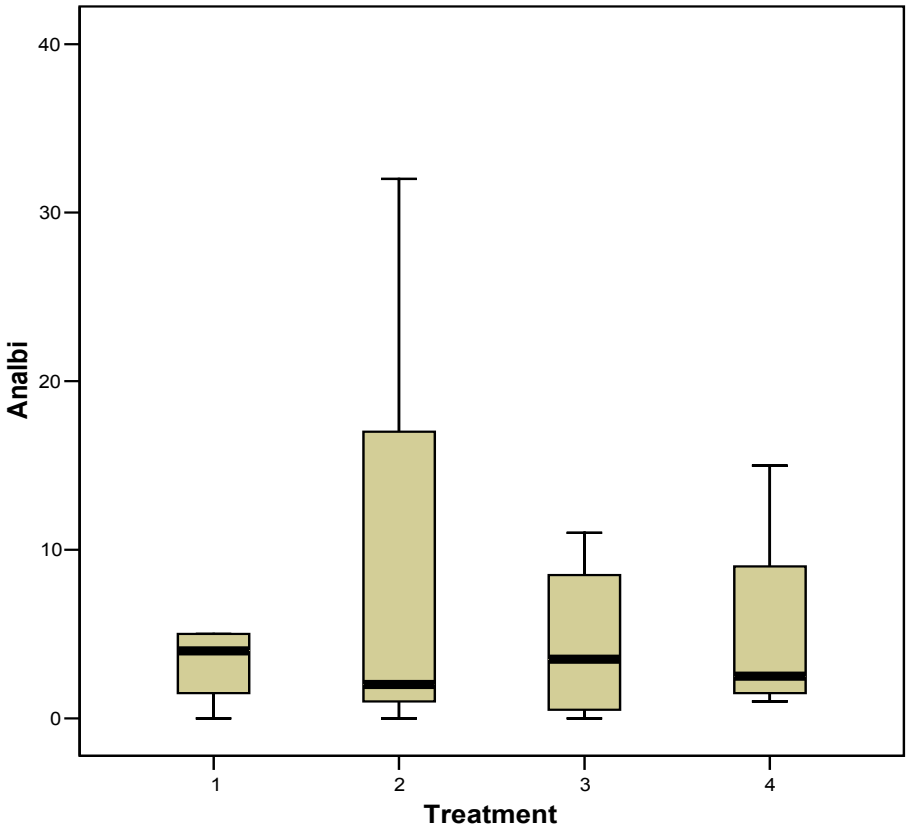
Explore

Treatment

Case Processing Summary

	Treatment	Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
Analbi	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Analbi


40
30
20
10
0
Analbi
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Ancrucians	1	4	8.63
	2	4	7.00
	3	4	11.00
	4	4	7.38
	Total	16	

Test Statistics(a,b)

	Ancrucians
Chi-Square	1.731
df	3
Asymp. Sig.	.630

a Kruskal Wallis Test
b Grouping Variable: Treatment

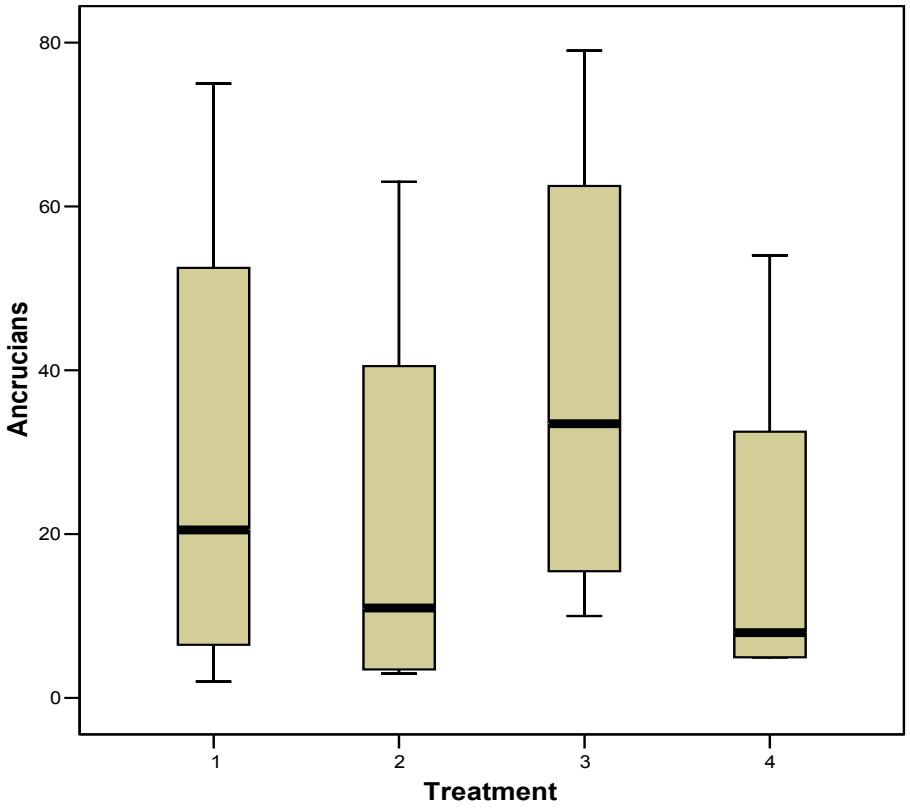
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Ancrucians	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Ancrucians


80
60
40
20
0
Ancrucians
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Anopheles	1	4	8.50
	2	4	7.75
	3	4	10.75
	4	4	7.00
	Total	16	

Test Statistics(a,b)

	Anopheles
Chi-Square	1.390
df	3
Asymp. Sig.	.708

a Kruskal Wallis Test
b Grouping Variable: Treatment

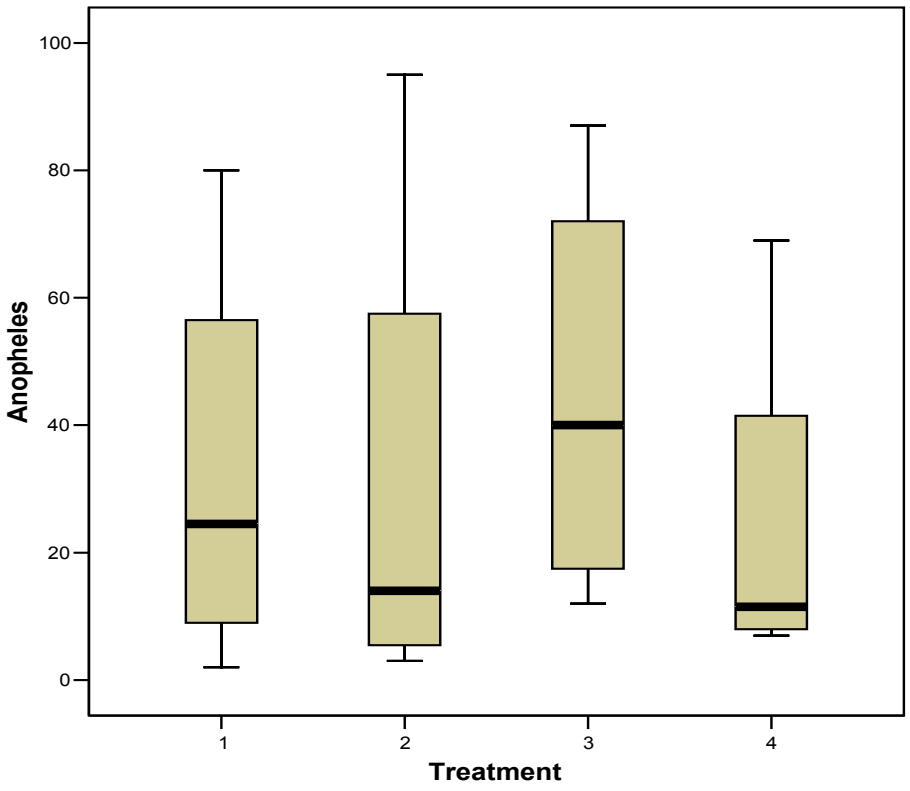
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Anopheles	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Anopheles


100
80
60
40
20
0
Anopheles
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Anvesti	1	4	5.00
	2	4	7.50
	3	4	11.63
	4	4	9.88
	Total	16	

Test Statistics(a,b)

	Anvesti
Chi-Square	5.474
df	3
Asymp. Sig.	.140

a Kruskal Wallis Test
b Grouping Variable: Treatment

Explore

Warnings

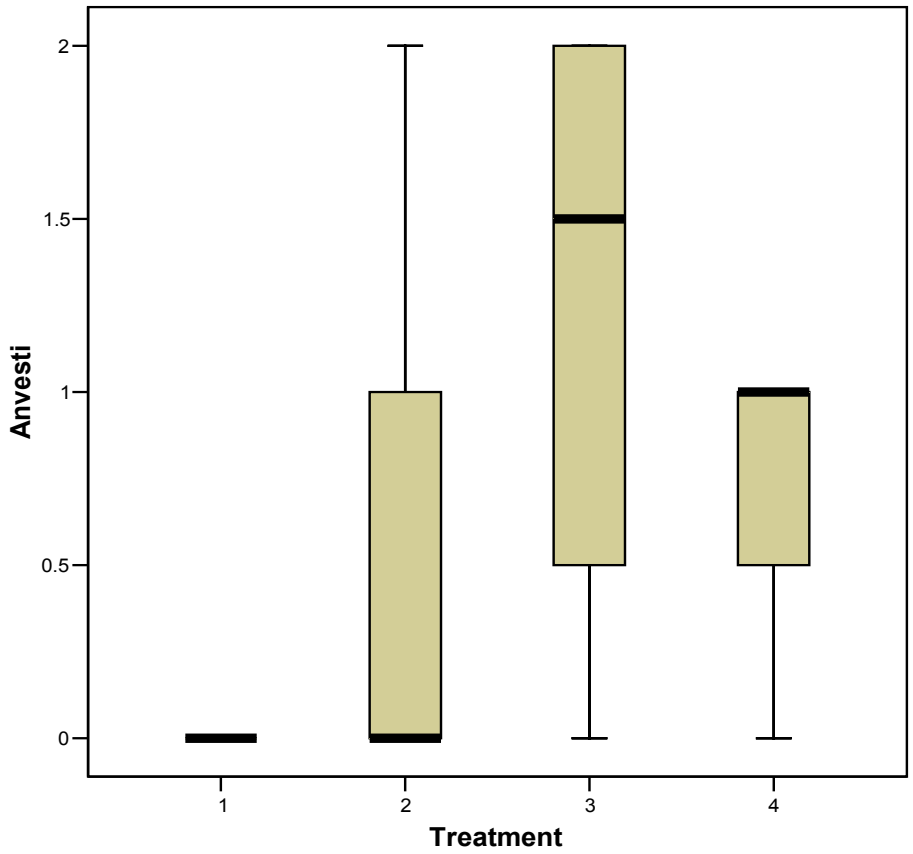
Anvesti is constant when Treatment = 1. It will be included in any boxplots produced but other output will be omitted.

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Anvesti	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Anvesti


Anvesti
2
1.5
1
0.5
0
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Coqnigricans	1	4	9.13
	2	4	9.63
	3	4	7.25
	4	4	8.00
	Total	16	

Test Statistics(a,b)

	Coqnigricans
Chi-Square	.617
df	3
Asymp. Sig.	.893

a Kruskal Wallis Test
b Grouping Variable: Treatment

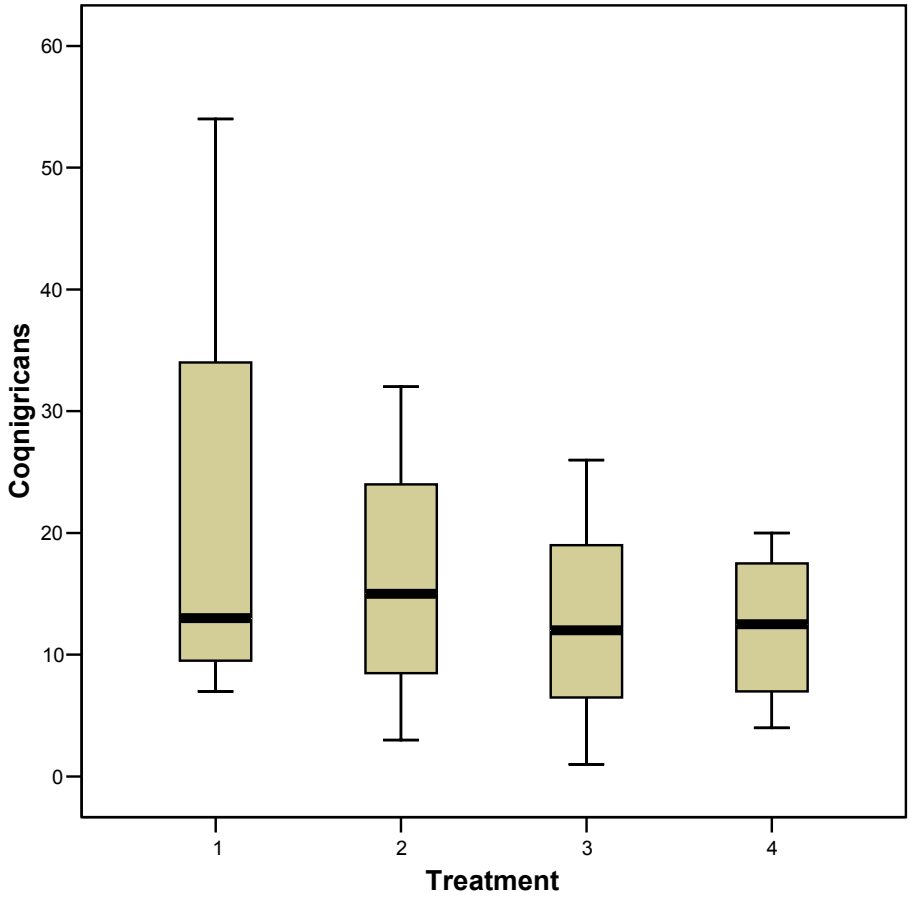
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Coqnigricans	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Coqnigricans


60
50
40
30
20
10
0
Coqnigricans
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Culicines	1	4	8.63
	2	4	7.63
	3	4	8.25
	4	4	9.50
	Total	16	

Test Statistics(a,b)

	Culicines
Chi-Square	.326
df	3
Asymp. Sig.	.955

a Kruskal Wallis Test
b Grouping Variable: Treatment

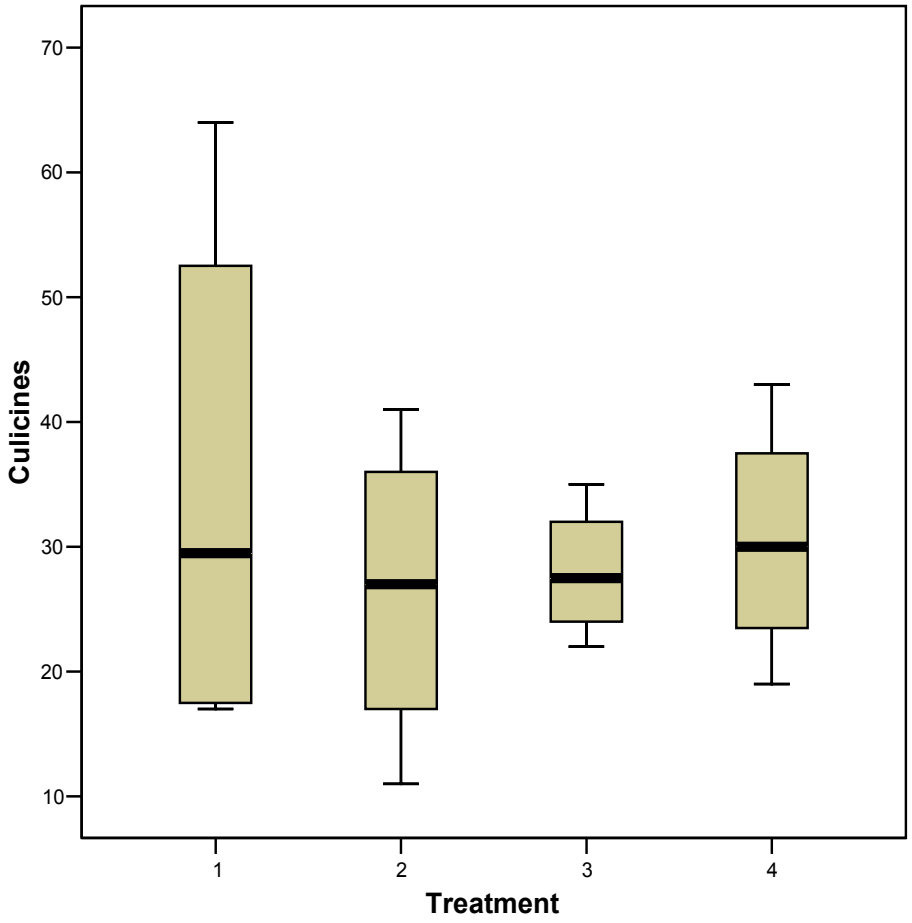
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Culicines	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Culicines


70
60
50
40
30
20
10
Culicines
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Cxculex	1	4	7.50
	2	4	8.75
	3	4	10.00
	4	4	7.75
	Total	16	

Test Statistics(a,b)

	Cxculex
Chi-Square	.832
df	3
Asymp. Sig.	.842

a Kruskal Wallis Test
b Grouping Variable: Treatment

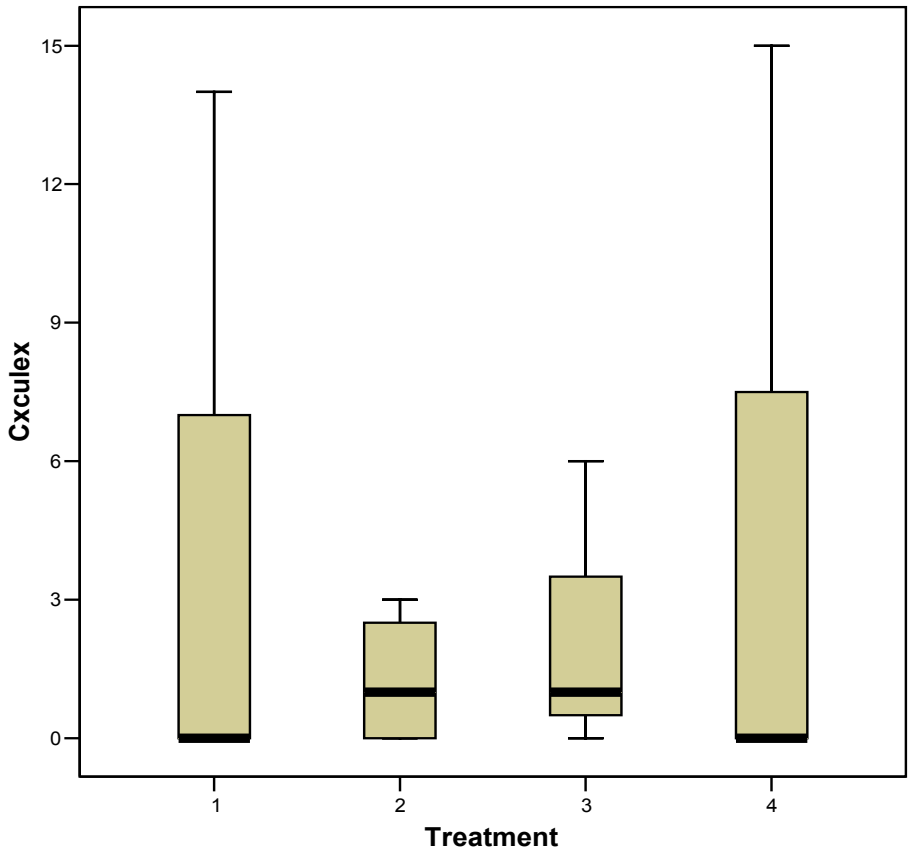
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Cxculex	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Cxculex


15
12
9
6
3
0
Cxculex
1
2
3
4
Treatment

NPar Tests

Kruskal-Wallis Test

Ranks

	Treatment	N	Mean Rank
Mantitillans	1	4	9.00
	2	4	7.63
	3	4	7.63
	4	4	9.75
	Total	16	

Test Statistics(a,b)

	Mantitillans
Chi-Square	.594
df	3
Asymp. Sig.	.898

a Kruskal Wallis Test
b Grouping Variable: Treatment

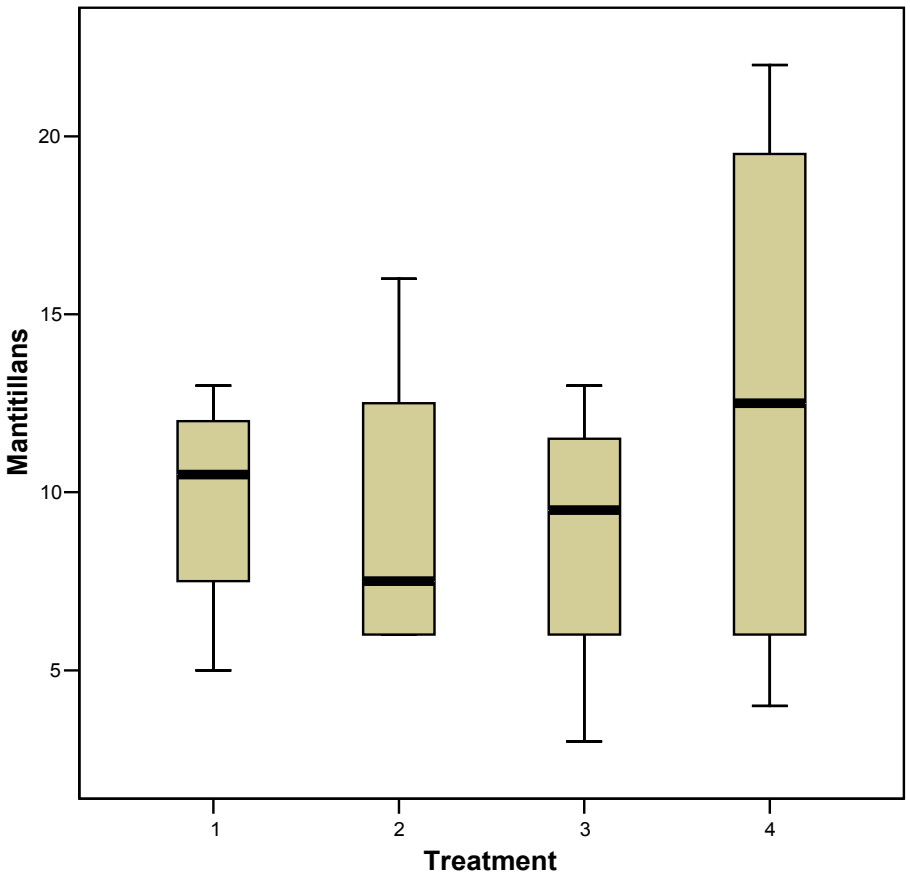
Explore

Treatment

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	Treatment	N	Percent	N	Percent	N	Percent
Mantitillans	1	4	100.0%	0	.0%	4	100.0%
	2	4	100.0%	0	.0%	4	100.0%
	3	4	100.0%	0	.0%	4	100.0%
	4	4	100.0%	0	.0%	4	100.0%

Mantitillans


Mantitillans
20
15
10
5
1
2
3
4
Treatment

Pre vs. Post Storm

```
  ___  ____  ____  ____  ____ tm
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   10.0   Copyright 1984-2007
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
                                      College Station, Texas 77845 USA
                                      800-STATA-PC      http://www.stata.com
                                      979-696-4600      stata@stata.com
                                      979-696-4601 (fax)

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       Serial number:  1910541069
         Licensed to:  WinXP120
                       USUHS/LRC

Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated to data


. /* Anopheles spp. PREvsPOST */
. iri 722 223 16 16

                 |   Exposed   Unexposed |      Total
-----------------+------------------------+-----------
           Cases |       722         223 |        945
     Person-time |        16          16 |         32
-----------------+------------------------+-----------
  Incidence Rate |    45.125     13.9375 |   29.53125
                 |      Point estimate    |   [95% Conf. Interval]
                 |------------------------+-----------------------
 Inc. rate diff. |          31.1875       |   27.42181    34.95319
 Inc. rate ratio |         3.237668       |   2.782449    3.779318 (exact)
 Attr. frac. ex. |         .6911357       |   .6406043     .735402 (exact)
 Attr. frac. pop |         .5280423       |
                 |------------------------+-----------------------
                     (midp)   Pr(k>=722) =                 0.0000 (exact)
                     (midp) 2*Pr(k>=722) =                 0.0000 (exact)


. /* An. albimanus PREvsPOST */
. iri 128 30 16 16

                 |   Exposed   Unexposed |      Total
-----------------+------------------------+-----------
           Cases |       128          30 |        158
     Person-time |        16          16 |         32
-----------------+------------------------+-----------
  Incidence Rate |         8       1.875 |     4.9375
                 |      Point estimate    |   [95% Conf. Interval]
                 |------------------------+-----------------------
 Inc. rate diff. |            6.125       |   4.585227    7.664773
 Inc. rate ratio |         4.266667       |   2.848737    6.580027 (exact)
 Attr. frac. ex. |          .765625       |   .6489673    .8480249 (exact)
 Attr. frac. pop |         .6202532       |
                 |------------------------+-----------------------
                     (midp)   Pr(k>=128) =                 0.0000 (exact)
                     (midp) 2*Pr(k>=128) =                 0.0000 (exact)
```

```
. /* An. crucians PREvsPOST */
. iri 587 183 16 16
```

	Exposed	Unexposed	Total
Cases	587	183	770
Person-time	16	16	32
Incidence Rate	36.6875	11.4375	24.0625

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	25.25	21.85083	28.64917	
Inc. rate ratio	3.20765	2.712663	3.807682	(exact)
Attr. frac. ex.	.6882453	.6313586	.737373	(exact)
Attr. frac. pop	.5246753			

(midp) Pr(k>=587) = 0.0000 (exact)
(midp) 2*Pr(k>=587) = 0.0000 (exact)

```
. /* An. vestitipennis PREvsPOST */
. iri 7 10 16 16
```

	Exposed	Unexposed	Total
Cases	7	10	17
Person-time	16	16	32
Incidence Rate	.4375	.625	.53125

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	-.1875	-.6925712	.3175712	
Inc. rate ratio	.7	.2261468	2.037232	(exact)
Prev. frac. ex.	.3	-1.037232	.7738532	(exact)
Prev. frac. pop	.15			

(midp) Pr(k<=7) = 0.2403 (exact)
(midp) 2*Pr(k<=7) = 0.4807 (exact)

```
. /* Culicines PREvsPOST */
. iri 415 391 16 16
```

	Exposed	Unexposed	Total
Cases	415	391	806
Person-time	16	16	32
Incidence Rate	25.9375	24.4375	25.1875

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	1.5	-1.977728	4.977728	
Inc. rate ratio	1.061381	.9222054	1.221744	(exact)
Attr. frac. ex.	.0578313	-.0843571	.1814981	(exact)
Attr. frac. pop	.0297767			

(midp) Pr(k>=415) = 0.1991 (exact)
(midp) 2*Pr(k>=415) = 0.3982 (exact)

```
. /* Cq. nigricans PREvsPOST */
. iri 264 42 16 16
```

	Exposed	Unexposed	Total
Cases	264	42	306
Person-time	16	16	32
Incidence Rate	16.5	2.625	9.5625

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	13.875	11.73216	16.01784	
Inc. rate ratio	6.285714	4.525807	8.926154	(exact)
Attr. frac. ex.	.8409091	.7790449	.8879697	(exact)
Attr. frac. pop	.7254902			

(midp) Pr(k>=264) = 0.0000 (exact)
(midp) 2*Pr(k>=264) = 0.0000 (exact)

```
. /* Mn. titillans PREvsPOST */
. iri 146 204 16 16
```

	Exposed	Unexposed	Total
Cases	146	204	350
Person-time	16	16	32
Incidence Rate	9.125	12.75	10.9375

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	-3.625	-5.916723	-1.333277	
Inc. rate ratio	.7156863	.5746806	.889463	(exact)
Prev. frac. ex.	.2843137	.110537	.4253194	(exact)
Prev. frac. pop	.1421569			

(midp) Pr(k<=146) = 0.0010 (exact)
(midp) 2*Pr(k<=146) = 0.0019 (exact)

```
.
. /* Cx. Cx. spp. PREvsPOST */
. iri 5 56 16 16
```

	Exposed	Unexposed	Total
Cases	5	56	61
Person-time	16	16	32
Incidence Rate	.3125	3.5	1.90625

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	-3.1875	-4.144238	-2.230762	
Inc. rate ratio	.0892857	.0279091	.221019	(exact)
Prev. frac. ex.	.9107143	.778981	.9720909	(exact)
Prev. frac. pop	.4553571			

(midp) Pr(k<=5) = 0.0000 (exact)
(midp) 2*Pr(k<=5) = 0.0000 (exact)

```
. /* Ae. taeniorhynchus PREvsPOST */
. iri 0 86 16 16
```

	Exposed	Unexposed	Total		
Cases	0	86	86		
Person-time	16	16	32		
Incidence Rate	0	5.375	2.6875		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	-5.375		-6.510997	-4.239003	
Inc. rate ratio	0		0	.0438272	(exact)
Prev. frac. ex.	1		.9561728	1	(exact)
Prev. frac. pop	1				
(midp) Pr(k<=0) =				0.0000	(exact)
(midp) 2*Pr(k<=0) =				0.0000	(exact)

```
. /* Ps. ferox PREvsPOST */
. iri 0 0 16 16
```

	Exposed	Unexposed	Total		
Cases	0	0	0		
Person-time	16	16	32		
Incidence Rate	0	0	0		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	0		0	0	
Inc. rate ratio	.		.	.	(exact)
Attr. frac. ex.	.		.	.	(exact)
Attr. frac. pop	.				
(midp) Pr(k>=0) =				0.5000	(exact)
(midp) 2*Pr(k>=0) =				1.0000	(exact)

```
. /* Ps. albipes PREvsPOST */
. iri 0 3 16 16
```

	Exposed	Unexposed	Total		
Cases	0	3	3		
Person-time	16	16	32		
Incidence Rate	0	.1875	.09375		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	-.1875		-.3996723	.0246723	
Inc. rate ratio	0		0	2.419952	(exact)
Prev. frac. ex.	1		-1.419952	1	(exact)
Prev. frac. pop	1				
(midp) Pr(k<=0) =				0.0625	(exact)
(midp) 2*Pr(k<=0) =				0.1250	(exact)

```
. /* ALL PREvsPOST */
. iri 1137 614 16 16
```

	Exposed	Unexposed	Total		
Cases	1137	614	1751		
Person-time	16	16	32		
Incidence Rate	71.0625	38.375	54.71875		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	32.6875		27.56159	37.81341	
Inc. rate ratio	1.851792		1.677173	2.046117	(exact)
Attr. frac. ex.	.4599824		.4037587	.5112693	(exact)
Attr. frac. pop	.2986865				

(midp) Pr(k>=1137) = 0.0000 (exact)
(midp) 2*Pr(k>=1137) = 0.0000 (exact)

Mosquito Magnet™ vs. CDC

```
  ___  ____  ____  ____  ____ tm
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   10.0   Copyright 1984-2007
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
                                      College Station, Texas 77845 USA
                                      800-STATA-PC      http://www.stata.com
                                      979-696-4600      stata@stata.com
                                      979-696-4601 (fax)

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       Serial number:  1910541069
         Licensed to:  WinXP120
                       USUHS/LRC

Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated to data


. /* Anopheles spp. MOSMAGvsCDC */
. iri 945 100 32 7

                 |   Exposed   Unexposed |      Total
-----------------+------------------------+-----------
           Cases |       945         100 |       1045
     Person-time |        32           7 |         39
-----------------+------------------------+-----------
  Incidence Rate |  29.53125    14.28571 |   26.79487
                 |      Point estimate    |    [95% Conf. Interval]
                 |------------------------+------------------------
 Inc. rate diff. |         15.24554       |     11.8714    18.61967
 Inc. rate ratio |         2.067188       |    1.680711     2.56652 (exact)
 Attr. frac. ex. |         .5162509       |    .4050138    .6103674 (exact)
 Attr. frac. pop |         .4668489       |
                 |------------------------+------------------------
                     (midp)   Pr(k>=945) =                 0.0000 (exact)
                     (midp) 2*Pr(k>=945) =                 0.0000 (exact)


. /* An. albimanus MOSMAGvsCDC */
. iri 158 0 32 7

                 |   Exposed   Unexposed |      Total
-----------------+------------------------+-----------
           Cases |       158           0 |        158
     Person-time |        32           7 |         39
-----------------+------------------------+-----------
  Incidence Rate |    4.9375           0 |   4.051282
                 |      Point estimate    |    [95% Conf. Interval]
                 |------------------------+------------------------
 Inc. rate diff. |           4.9375       |    4.167614    5.707386
 Inc. rate ratio |                .       |    9.260427           . (exact)
 Attr. frac. ex. |                1       |    .8920136           1 (exact)
 Attr. frac. pop |                1       |
                 |------------------------+------------------------
                     (midp)   Pr(k>=158) =                 0.0000 (exact)
                     (midp) 2*Pr(k>=158) =                 0.0000 (exact)
```

```
.
. /* An. crucians MOSMAGvsCDC */
. iri 770 100 32 7
```

	Exposed	Unexposed	Total		
Cases	770	100	870		
Person-time	32	7	39		
Incidence Rate	24.0625	14.28571	22.30769		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	9.776786		6.501376	13.0522	
Inc. rate ratio	1.684375		1.366084	2.095911	(exact)
Attr. frac. ex.	.406308		.2679807	.5228804	(exact)
Attr. frac. pop	.3596059				

(midp) Pr(k>=770) = 0.0000 (exact)
(midp) 2*Pr(k>=770) = 0.0000 (exact)

```
. /* An. crucians unstable removed MOSMAGvsCDC */
. iri 770 26 32 6
```

	Exposed	Unexposed	Total		
Cases	770	26	796		
Person-time	32	6	38		
Incidence Rate	24.0625	4.333333	20.94737		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	19.72917		17.34946	22.10887	
Inc. rate ratio	5.552885		3.760309	8.555596	(exact)
Attr. frac. ex.	.8199134		.7340644	.8831174	(exact)
Attr. frac. pop	.7931323				

(midp) Pr(k>=770) = 0.0000 (exact)
(midp) 2*Pr(k>=770) = 0.0000 (exact)

```
.
. /* An. vestitipennis MOSMAGvsCDC */
. iri 17 0 32 7
```

	Exposed	Unexposed	Total		
Cases	17	0	17		
Person-time	32	7	39		
Incidence Rate	.53125	0	.4358974		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	.53125		.2787144	.7837856	
Inc. rate ratio	.		.902675	.	(exact)
Attr. frac. ex.	1		-.1078185	1	(exact)
Attr. frac. pop	1				

(midp) Pr(k>=17) = 0.0173 (exact)
(midp) 2*Pr(k>=17) = 0.0346 (exact)

```
. /* Culicines MOSMAGvsCDC */
. iri 805 43 32 7
```

	Exposed	Unexposed	Total
Cases	805	43	848
Person-time	32	7	39
Incidence Rate	25.15625	6.142857	21.74359

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	19.01339	16.48536	21.54143	
Inc. rate ratio	4.095203	3.012514	5.703505	(exact)
Attr. frac. ex.	.7558119	.6680514	.8246692	(exact)
Attr. frac. pop	.7174865			

(midp) Pr(k>=805) = 0.0000 (exact)
(midp) 2*Pr(k>=805) = 0.0000 (exact)

```
. /* Cq. nigricans MOSMAGvsCDC */
. iri 306 14 32 7
```

	Exposed	Unexposed	Total
Cases	306	14	320
Person-time	32	7	39
Incidence Rate	9.5625	2	8.205128

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	7.5625	6.064002	9.060998	
Inc. rate ratio	4.78125	2.806159	8.849809	(exact)
Attr. frac. ex.	.7908497	.643641	.8870032	(exact)
Attr. frac. pop	.75625			

(midp) Pr(k>=306) = 0.0000 (exact)
(midp) 2*Pr(k>=306) = 0.0000 (exact)

```
.
. /* Mn. titillans MOSMAGvsCDC */
. iri 350 26 32 7
```

	Exposed	Unexposed	Total
Cases	350	26	376
Person-time	32	7	39
Incidence Rate	10.9375	3.714286	9.641026

	Point estimate	[95% Conf.	Interval]	
Inc. rate diff.	7.223214	5.392552	9.053876	
Inc. rate ratio	2.944712	1.975777	4.571632	(exact)
Attr. frac. ex.	.6604082	.4938699	.7812597	(exact)
Attr. frac. pop	.6147416			

(midp) Pr(k>=350) = 0.0000 (exact)
(midp) 2*Pr(k>=350) = 0.0000 (exact)

```
. /* Cx. Cx. spp. MOSMAGvsCDC */
. iri 61 2 32 7
```

	Exposed	Unexposed	Total		
Cases	61	2	63		
Person-time	32	7	39		
Incidence Rate	1.90625	.2857143	1.615385		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	1.620536		.9995437	2.241528	
Inc. rate ratio	6.671875		1.769536	56.33528	(exact)
Attr. frac. ex.	.8501171		.4348802	.9822491	(exact)
Attr. frac. pop	.8231293				

(midp) Pr(k>=61) = 0.0002 (exact)
(midp) 2*Pr(k>=61) = 0.0005 (exact)

```
. /* Ae. taeniorhynchus MOSMAGvsCDC */
. iri 86 0 32 7
```

	Exposed	Unexposed	Total		
Cases	86	0	86		
Person-time	32	7	39		
Incidence Rate	2.6875	0	2.205128		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	2.6875		2.119501	3.255499	
Inc. rate ratio	.		4.991194	.	(exact)
Attr. frac. ex.	1		.7996471	1	(exact)
Attr. frac. pop	1				

(midp) Pr(k>=86) = 0.0000 (exact)
(midp) 2*Pr(k>=86) = 0.0000 (exact)

```
. /* Ps. ferox MOSMAGvsCDC */
. iri 0 1 32 7
```

	Exposed	Unexposed	Total		
Cases	0	1	1		
Person-time	32	7	39		
Incidence Rate	0	.1428571	.025641		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	-.1428571		-.422852	.1371377	
Inc. rate ratio	0		0	8.53125	(exact)
Prev. frac. ex.	1		-7.53125	1	(exact)
Prev. frac. pop	1				

(midp) Pr(k<=0) = 0.0897 (exact)
(midp) 2*Pr(k<=0) = 0.1795 (exact)

```
.
. /* Ps. albipes MOSMAGvsCDC */
. iri 3 0 32 7
```

	Exposed	Unexposed	Total		
Cases	3	0	3		
Person-time	32	7	39		
Incidence Rate	.09375	0	.0769231		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	.09375		-.0123362	.1998362	
Inc. rate ratio	.		.0903944	.	(exact)
Attr. frac. ex.	1		-10.06264	1	(exact)
Attr. frac. pop	1				
(midp) Pr(k>=3) =				0.2762	(exact)
(midp) 2*Pr(k>=3) =				0.5524	(exact)

```
. /* ALL MOSMAGvsCDC */
. iri 1750 143 32 7
```

	Exposed	Unexposed	Total		
Cases	1750	143	1893		
Person-time	32	7	39		
Incidence Rate	54.6875	20.42857	48.53846		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	34.25893		30.0428	38.47506	
Inc. rate ratio	2.67701		2.256361	3.197205	(exact)
Attr. frac. ex.	.626449		.5568085	.6872269	(exact)
Attr. frac. pop	.5791261				
(midp) Pr(k>=1750) =				0.0000	(exact)
(midp) 2*Pr(k>=1750) =				0.0000	(exact)

```
. /* ALL unstable removed MOSMAGvsCDC */
```

Baited CDC vs. Unbaited CDC

```
  ___  ____  ____  ____  ____ tm
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   10.0   Copyright 1984-2007
  Statistics/Data Analysis             StataCorp
                                       4905 Lakeway Drive
                                       College Station, Texas 77845 USA
                                       800-STATA-PC        http://www.stata.com
                                       979-696-4600        stata@stata.com
                                       979-696-4601 (fax)

30-student Stata for Windows (network) perpetual license:
       Serial number:  1910541069
         Licensed to:  WinXP120
                       USUHS/LRC

Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated to data


. /* Anopheles spp bCDCvsuCDC */
. iri 143 0 10 10

                  |  Exposed   Unexposed  |      Total
------------------+-----------------------+-----------
            Cases |      143           0  |        143
      Person-time |       10          10  |         20
------------------+-----------------------+-----------
   Incidence Rate |     14.3           0  |       7.15
                  |                       |
                  |  Point estimate       |  [95% Conf. Interval]
------------------+-----------------------+-----------
  Inc. rate diff. |        14.3           |   11.95622    16.64378
  Inc. rate ratio |           .           |   38.26731           . (exact)
  Attr. frac. ex. |           1           |    .973868           1 (exact)
  Attr. frac. pop |           1           |
------------------+-----------------------+-----------
                       (midp)   Pr(k>=143) =                0.0000 (exact)
                       (midp) 2*Pr(k>=143) =                0.0000 (exact)


. /* An. albimanus bCDCvsuCDC */
. iri 1 0 10 10

                  |  Exposed   Unexposed  |      Total
------------------+-----------------------+-----------
            Cases |        1           0  |          1
      Person-time |       10          10  |         20
------------------+-----------------------+-----------
   Incidence Rate |       .1           0  |        .05
                  |                       |
                  |  Point estimate       |  [95% Conf. Interval]
------------------+-----------------------+-----------
  Inc. rate diff. |          .1           |  -.0959964    .2959964
  Inc. rate ratio |           .           |    .025641           . (exact)
  Attr. frac. ex. |           1           |         -38           1 (exact)
  Attr. frac. pop |           1           |
------------------+-----------------------+-----------
                       (midp)   Pr(k>=1) =                0.2500 (exact)
                       (midp) 2*Pr(k>=1) =                0.5000 (exact)
```

```
. /* An. crucians bCDCvsuCDC */
. iri 142 0 10 10
```

	Exposed	Unexposed	Total		
Cases	142	0	142		
Person-time	10	10	20		
Incidence Rate	14.2	0	7.1		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	14.2		11.86443	16.53557	
Inc. rate ratio	.		37.99624	.	(exact)
Attr. frac. ex.	1		.9736816	1	(exact)
Attr. frac. pop	1				

(midp) Pr(k>=142) = 0.0000 (exact)
(midp) 2*Pr(k>=142) = 0.0000 (exact)

```
. /* An. vestitipennis bCDCvsuCDC */
. iri 0 0 10 10
```

	Exposed	Unexposed	Total		
Cases	0	0	0		
Person-time	10	10	20		
Incidence Rate	0	0	0		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	0		0	0	
Inc. rate ratio	.		.	.	(exact)
Attr. frac. ex.	.		.	.	(exact)
Attr. frac. pop	.				

(midp) Pr(k>=0) = 0.5000 (exact)
(midp) 2*Pr(k>=0) = 1.0000 (exact)

```
.
. /* Culicines bCDCvsuCDC */
. iri 50 14 10 10
```

	Exposed	Unexposed	Total		
Cases	50	14	64		
Person-time	10	10	20		
Incidence Rate	5	1.4	3.2		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	3.6		2.032029	5.167971	
Inc. rate ratio	3.571429		1.943806	6.995633	(exact)
Attr. frac. ex.	.72		.4855453	.8570537	(exact)
Attr. frac. pop	.5625				

(midp) Pr(k>=50) = 0.0000 (exact)
(midp) 2*Pr(k>=50) = 0.0000 (exact)

```
.
. /* Cq. nigricans bCDCvsuCDC */
.
. iri 18 11 10 10
```

	Exposed	Unexposed	Total		
Cases	18	11	29		
Person-time	10	10	20		
Incidence Rate	1.8	1.1	1.45		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	.7		-.3554729	1.755473	
Inc. rate ratio	1.636364		.7319155	3.833984	(exact)
Attr. frac. ex.	.3888889		-.3662778	.7391747	(exact)
Attr. frac. pop	.2413793				
	(midp) Pr(k>=18) =			0.1002	(exact)
	(midp) 2*Pr(k>=18) =			0.2005	(exact)

```
.
. /* Mn. titillans bCDCvsuCDC */
. iri 29 3 10 10
```

	Exposed	Unexposed	Total		
Cases	29	3	32		
Person-time	10	10	20		
Incidence Rate	2.9	.3	1.6		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	2.6		1.491277	3.708723	
Inc. rate ratio	9.666667		2.996372	49.58891	(exact)
Attr. frac. ex.	.8965517		.6662631	.9798342	(exact)
Attr. frac. pop	.8125				
	(midp) Pr(k>=29) =			0.0000	(exact)
	(midp) 2*Pr(k>=29) =			0.0000	(exact)

```
. /* Cx. Cx. spp. bCDCvsuCDC */
. iri 2 0 10 10
```

	Exposed	Unexposed	Total		
Cases	2	0	2		
Person-time	10	10	20		
Incidence Rate	.2	0	.1		
	Point estimate		[95% Conf.	Interval]	
Inc. rate diff.	.2		-.0771808	.4771808	
Inc. rate ratio	.		.1878091	.	(exact)
Attr. frac. ex.	1		-4.324555	1	(exact)
Attr. frac. pop	1				
	(midp) Pr(k>=2) =			0.1250	(exact)
	(midp) 2*Pr(k>=2) =			0.2500	(exact)

```
. /* Ae. taeniorhynchus bCDCvsuCDC */
. iri 0 0 10 10
```

	Exposed	Unexposed	Total		
Cases	0	0	0		
Person-time	10	10	20		
Incidence Rate	0	0	0		
	Point estimate		[95% Conf. Interval]		
Inc. rate diff.	0		0	0	
Inc. rate ratio	.		.	.	(exact)
Attr. frac. ex.	.		.	.	(exact)
Attr. frac. pop	.				
(midp) Pr(k>=0) =				0.5000	(exact)
(midp) 2*Pr(k>=0) =				1.0000	(exact)

```
. /* Ps. ferox bCDCvsuCDC */
. iri 1 0 10 10
```

	Exposed	Unexposed	Total		
Cases	1	0	1		
Person-time	10	10	20		
Incidence Rate	.1	0	.05		
	Point estimate		[95% Conf. Interval]		
Inc. rate diff.	.1		-.0959964	.2959964	
Inc. rate ratio	.		.025641	.	(exact)
Attr. frac. ex.	1		-38	1	(exact)
Attr. frac. pop	1				
(midp) Pr(k>=1) =				0.2500	(exact)
(midp) 2*Pr(k>=1) =				0.5000	(exact)

```
. /* Ps. albipes bCDCvsuCDC */
. iri 0 0 10 10
```

	Exposed	Unexposed	Total		
Cases	0	0	0		
Person-time	10	10	20		
Incidence Rate	0	0	0		
	Point estimate		[95% Conf. Interval]		
Inc. rate diff.	0		0	0	
Inc. rate ratio	.		.	.	(exact)
Attr. frac. ex.	.		.	.	(exact)
Attr. frac. pop	.				
(midp) Pr(k>=0) =				0.5000	(exact)
(midp) 2*Pr(k>=0) =				1.0000	(exact)

```
. /* ALL bCDCvsuCDC */
. iri 193 14 10 10
```

	Exposed	Unexposed	Total		
Cases	193	14	207		
Person-time	10	10	20		
Incidence Rate	19.3	1.4	10.35		
	Point estimate		[95% Conf. Interval]		
Inc. rate diff.	17.9		15.0801	20.7199	
Inc. rate ratio	13.78571		8.019284	25.69088	(exact)
Attr. frac. ex.	.9274611		.8753006	.9610757	(exact)
Attr. frac. pop	.8647343				

(midp) Pr(k>=193) = 0.0000 (exact)
(midp) 2*Pr(k>=193) = 0.0000 (exact)

DAILY CLIMATE/CATTLE DATA
(climate data gathered from Belize City, BZ by Weather.com)
Red[1] = Control Study
Blue[2] = Standard Study
Green[3] = Post Storm

22 May 2008:	5 traps/5 tents/no treatment
Temperature (min-max):	28°C-31°C
Humidity:	79%
Precipitation:	NONE
Cattle Presence:	NO

(DAY 1)[1] 23 May 2008:	5 tents/3 treated/control/CDC
Temperature (min-max):	28°C-32°C
Humidity:	79%
Precipitation:	NONE
Cattle Presence:	YES

(DAY 2)[1] 24 May 2008:	5 tents/3 treated/control/CDC
Temperature (min-max):	29°C-34°C
Humidity:	68%
Precipitation:	NONE
Cattle Presence:	NO

(DAY 3)[1] 25 May 2008:	5 tents/3 treated/control/CDC
Temperature (min-max):	29°C-31°C
Humidity:	74%
Precipitation:	NONE
Cattle Presence:	NO

(DAY 4)[1] 26 May 2008:	5 tents/3 treated/control/CDC
Temperature (min-max):	28°C-30°C
Humidity:	66%
Precipitation:	NONE
Cattle Presence:	YES

(DAY 1)[2] 27 May 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	24°C-31°C
Humidity:	79%
Precipitation:	NONE
Cattle Presence:	NO

(DAY 2)[2] 28 May 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	25°C-32°C
Humidity:	55%
Precipitation:	YES
Cattle Presence:	NO

(DAY 3)[2] 29 May 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	24°C-31°C
Humidity:	74%
Precipitation:	YES
Cattle Presence:	NO

May 30-June 2: TROPICAL STORMS ALMA/ARTHUR (~20in. rain)

(DAY 4/DAY 1)[2&3] 3 June 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	26°C-30°C
Humidity:	84%
Precipitation:	YES
Cattle Presence:	NO

(DAY 2)[3] 4 June 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	27°C-29°C
Humidity:	84%
Precipitation:	YES
Cattle Presence:	NO

(DAY 3)[3] 5 June 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	25°C-30°C
Humidity:	74%
Precipitation:	NO
Cattle Presence:	YES

(DAY 4)[3] 6 June 2008:	5 tents/3 treated/standard/CDC
Temperature (min-max):	28°C-31°C
Humidity:	79%
Precipitation:	YES
Cattle Presence:	NO